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UNITED STATES CIVILIAN SPACE POLICY

HEARINGS

BEFORE THE

SUBCOMMITTEE ON
SPACE SCIENCE AND APPLICATIONS

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

NINETY-SIXTH CONGRESS

SECOND SESSION

JULY 23, 24, 1980

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CONTENTS

WITNESSES

July 23, 1980: Page
- Dr. Thomas O. Paine, president, Northrop Corp. 2
- Dr. Rocco Petrone, president and chief executive officer, National Center for Resource Recovery 32

July 24, 1980:
- Dr. Frank Press, Science Adviser to the President, Office of Science and Technology Policy, The White House 56
- Dr. Robert A. Frosch, Administrator, National Aeronautics and Space Administration 74
- Hon. Hans Mark, Secretary, Department of Air Force 92

AFTERNOON SESSION

Dr. James C. Fletcher, Burroughs Corp. 122

APPENDIX

ADDITIONAL STATEMENTS FOR THE RECORD

Dr. Bruce Friedman 153
Howard Kurtz 224

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UNITED STATES CIVILIAN SPACE POLICY

WEDNESDAY, JULY 23, 1980

House of Representatives,
Committee on Science and Technology,
Subcommittee on Space Science and Applications,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10:08 a.m., in room 2325, Rayburn House Office Building, Hon. Don Fuqua, chairman of the subcommittee, presiding.

Mr. Fuqua. The subcommittee will be in order.

Today the Subcommittee on Space Science and Applications begins 2 days of hearings into the Nation's civilian space policy. The Space Shuttle delays and funding problems are threatening the health of our space science and applications programs.

We are facing increasing competition in space activities. For example, the Europeans are developing their own launch capability and remote sensing systems are being planned by both France and Japan. The Soviets launched 87 space sorties in 1979, while the United States conducted only 16 launches. The Soviets also have surpassed the United States in manned space flight hours.

Our current capabilities for manned space flight are lagging significantly behind those of the Soviet Union and will continue to do so until the Space Shuttle begins operation, and we develop the auxiliary systems necessary to extend the duration of Space Shuttle missions.

During these hearings, the subcommittee will examine the wisdom of the administration's contention that there is no need to initiate new, high challenge, high visibility engineering missions.

Further, the subcommittee will attempt to develop and articulate long-range policy goals of the civilian space program and to examine the balance between civilian and military space activities. Other issues include the decline of our national capability through the erosion of NASA's institutional base.

Our first witness today is Dr. Thomas O. Paine, current president of Northrop Corp. and previously a distinguished Administrator of NASA.

Our second witness will be Dr. Rocco Petrone, president and chief executive officer of the National Center for Resource Recovery, who previously served with NASA as Director of Marshall Space Flight Center and Associate Administrtaor for Programs at Headquarters.

We are happy to welcome our first witness this morning, who is Dr. Paine. We are happy to have you before us again.

STATEMENT OF DR. THOMAS O. PAINE, NORTHROP CORP.

Dr. PAINE. This room certainly brings back an awful lot of memories.

Mr. Chairman and members of the subcommittee, I deeply appreciate the opportunity to appear once again before this committee. These hearings on U.S. space policy are being held at a critical time for the future of our national space program.

We are on the threshold of a new era in space made possible by the Space Shuttle. Yet we seem to have lost both our sense of direction and our resolution. The bold, successful and rewarding space initiatives of the 1960's stand in stark contrast to today's irresolution and drift.

The policy indecision is clear, rhetoric calling for U.S. leadership in space, accompanied by program cutbacks.

To reenergize our space program, we must establish promising new, long-range goals in science, in technology, and in economic applications. We must initiate reliable, low-cost, shuttle-based transportation to orbit, followed later by a practical, reusable, interorbit, and lunar transportation system. We must build permanent research and operating bases in low-Earth orbit, in geosynchonous orbit, and later on the Moon.

Before discussing these long-range proposals, I should note that exactly 11 years ago today, on Wednesday, July 23, 1969, the Apollo II astronauts were 116,000 miles from Earth in their 18-ton spacecraft *Columbia* returning from men's first exploration of the lunar surface. This expedition marked the culmination of an act of American faith and self-confidence which fulfilled President Kennedy's vision that America must become the leading spacefaring nation.

The whole world cheered this exploit, recognizing human intelligence had transported terrestrial life across 250,000 miles to initiate travel to other worlds.

The Apollo era of the 1960's and early 1970's was characterized by burgeoning U.S. space initiatives in science, exploration, and application. As a result of our initiatives in the 1960's, the 1970's saw NASA's far-ranging spacecraft exploring the planets of Mercury, Venus, Mars, Jupiter, and Saturn.

This November the first of two Voyager spacecraft launched in 1977 will transmit back to Earth a more detailed look at Saturn and six of its moons, after which one spacecraft will proceed on out to distant Uranus.

In parallel with our exploration of the solar system's six innermost planets and their moons, Skylab astronauts have studied the Sun in unprecedented detail, and NASA's Orbiting Astronomical Observatories have been scanning the farthest reaches of the universe using frequencies of light, X-rays, and gamma rays that cannot penetrate the atmosphere to Earth-based observatories.

Spectacular new cosmological phenomena are under study, from highly energetic quasars that emit unaccountaby extravagant energy, to superdense neutron stars and possible black holes that appear to be devouring matter. On the practical side, whole new industries are springing up to provide satellite-based services over an ever-broadening spectrum from communications and weather forecasting to navigation and Earth resource analysis.

This space activity initiated in the 1960's has generated spectacular new knowledge. From this I believe that our greatest single return has been an enormous widening of man's horizons.

In addition to this mind stretching, we have achieved many direct benefits from space-initiated technological advances in such fields as computers, electronics, medicine, manufacturing, agriculture, transportation, energy, and many others.

On the geopolitical scale, the new availability of satellite verification has made possible realistic arms control negotiations. On the human scale, people in 100 nations are now linked together by satellite communications. Indeed, a burgeoning communications satellite industry is providing a vital global communications system that increasingly permeates the social, economic, and governmental elements of our planet.

This vigorous new space-age industry, in which the United States is still pre-eminent, stems directly from our space program. Private enterprise has now raised and invested more than 1 billion in orbiting comsats, with a growth trend that indicates another doubling in the next few years. In similar fashion, satellite remote sensing has grown from small weather satellites to large, multiple application satellites, initiating another new space-age industry with major future implications for agriculture, transportation, mining, cartography, environmental analysis, oceanography, and many other fields.

Thus, our space initiatives of the 1960's have provided rewarding gains in exploration, science, and applications, but in the 1970's caution replaced self-confidence, and America's vision of the future degenerated to reduced expectations. We have turned back from the limitless horizons of space to the confining notion of zero growth.

Having lost the momentum of the 1960's, we find today a greatly diminished NASA program. As an overall measurement, NASA's budgets of the mid 1960's would exceed $14 billion in today's dollars, in stark contrast to its 1981 budget of $5.5 billion.

NASA's highly productive science program has been substantially curtailed, with only three planetary missions to be launched in this decade, and the content and pace of our solar system exploration program subject to debilitating uncertainty.

A recent GAO study bears directly on the health of our Nation's space technology efforts. In a report headlined "U.S. Must Spend More to Maintain Lead in Space Technology," the GAO states that,

> Interest in developing space for economic purposes has grown to the point that it is now a truly international enterprise. However, the U.S.'s conservative approach does not compare favorably to the specific long-term plans of the 11 members of the European Space Agency, especially West Germany, nor to the plans of the Soviet Union and Japan.

When the Government auditors say we have lost vision, Mr. Chairman, we have lost vision.

Our most recent national space policy pronouncement calls for U.S. leadership, but states that high-challenge initiatives would not be appropriate at this time, and that decisions concerning needed new directions for our space programs should be deferred until after the Space Shuttle.

Ringing rhetoric proclaiming U.S. leadership in space is no substitute for plans and programs. In my view it is self-delusive to give lip service to leadership while avoiding initiative and commitment. America faces a clear choice today: Should we reinvigorate our space program or continue to drift downward? Continuing to coast amounts to a voluntary surrender of leadership in this century's most promising field of exploration.

I believe that we cannot afford to coast any longer. It is past time to set new goals that will reinvigorate our national space program. Let me share with you some thoughts on the nature of America's potential future in space and the policy direction which I believe we should now give to our space program.

The key and initial requirement for expanded space operations is low-cost, reliable space transportation. The Space Shuttle promises a breakthrough in the transportation of payloads and crews from Earth to low Earth orbit for the rest of this century, providing flexible, reliable, and economical round-trip operations. It will be critically important during the next few years to develop the full potential of the Shuttle through a vigorous operational flight schedule and improvement program as we move down the learning curve.

Opportunities for further advances appear likely with increased levels of activity, since the number of applications for scheduled Shuttle payloads already exceeds the planned flight capability of the limited Shuttle fleet now authorized.

Beyond this, the capability for reusable round-trip vehicles for operations beyond Low Earth Orbit within the Earth-Moon system should be developed if our space transportation system is to support the vigorous exploration and development of the new continent that lies above us in space.

Earth orbit is indeed a new continent overlooking the entire earth below to which we are exporting increasing payloads, and from which we are importing in return valuable services and data. We should now establish a permanent presence within this new continent to capitalize more rapidly on a myriad of major space opportunities.

We know, for instance, that communications satellite services are projected to double in the next few years. Similiarly, remote sensing satellites—the weathersats, geosats, landsats, seasats, reconsats, navsats, and others—represent a growing economic requirement for orbital monitoring of earth and space.

The quantitative growth in communications and remote sensing services will be accompanied by qualitative increases in levels of performance and flexibility that must be fitted into the already crowded Geosynchronous Earth Orbit slots 23,000 miles above the Earth's equator. The inevitable growth patterns in orbital activities vital to our society and our economy calls for better management of increasingly scarce frequencies and orbital slots, supported by increasingly capable space infrastructure in both low and Geosynchronous Earth Orbits.

The information and communications environment of orbital space in the future will include large platforms supporting multiple instruments and data handling facilities, large antenna farms, communication switching and multiplexing centers, multiantenna navigation and tracking stations, all interconnected by laser beam communication links.

The continued scientific exploration of the universe within and beyond our solar system is also of fundamental importance. There are many advantages in using Earth orbit as an operational base in such programs. For instance, our experience with the High Energy Astronomical Observatory, HEAO, and the expectations for the space telescope demonstrate the need for larger astronomy facilities in orbit, facilities where scientific studies can be done with flexibility in response to targets of opportunity.

Similarly, it is clear that in the exploration of the solar system robot spacecraft launched from well-equipped orbital platforms would have substantial advantages in payload and flexibility over those launched from the Earth's surface. The assembly, fueling, checkout, launching, and docking of both scientific spacecraft and application satellites will be routinely carried out from orbiting bases.

The unique environment provided by the vacuum and weightlessness of space has long been recognized, and initial experiments, such as those of Skylab, have confirmed the promise of orbiting laboratories. The limited steps that are now being planned for the Shuttle and Spacelab are too timid, as characterized by the General Accounting Office. I would recommend the NASA/McDonnell-Douglas joint agreement for space R. & D. however, as a positive step that may be the first of such arrangements.

Indeed, the routine conduct of opportunistic research in laboratories in space is an activity whose time has come. Research and experimentation in medicine, space construction, new materials, solar energy, optics, space manufacturing, robotics, tracking and navigation, Earth observation and other disciplines will be continuing activities in space for decades to come.

We need to explore new ideas that utilize the availability of unlimited energy, ready sources of lunar and asteroidal materials, and the benign characteristics of weightless, atmosphere-free space. Now is the time to plan and initiate work on the essential initial orbiting bases.

Mr. Chairman, these projections of the Nation's future potential in space are not unduly optimistic. They are consistent with our progress over the past two decades, and with our national experience with the application of new technology in other areas. We should recall that 40 years after Ford's assembly line, 40 million Americans owned automobiles, and 40 years after Lindbergh's flight, 20,000 people were jetting across the Atlantic every day.

We are barely into the space age, but already the United States has placed 1,000 payloads in orbit, including systems and instruments whose capability, sophistication and accuracy were unheard of a few years ago. We must be realistic, but we must not let our vision and plans for the future be obscured by the myopia and timidity all too prevalent today.

The revitalization of our Nation's civilian space program is necessary for our national security, for the growth of our economy, for our technical leadership, and for an improved understanding of our universe and its origins. In developing new policies and goals to govern this revitalization, I suggest the following points be considered.

Mr. **Fuqua.** Let me interrupt. You are getting into your conclusions, and we have a rollcall, and we have to take a short recess. We will come back in a moment so that you can conclude.

Dr. **Paine.** Yes.

[Whereupon, a short recess was taken.]

Mr. **Fuqua.** The subcommittee will resume.

You may continue where you left off.

Dr. **Paine.** First, we must develop new policy statements that set forth measurable goals and timetables, in science, in application, and in the progressive development of the infrastructure needed to support man's presence in space.

For example, we should schedule the exploration of each planet in the solar system by robot spacecraft, the experimental capture of solar power in orbit and its electrical transmission to Earth, the establishment of major radio and optical telescopes in space, the creation and operation of a manned lunar research station, and other long-range goals that can provide clear policy direction beyond the near term.

Second, we must create certain key capabilities which are critical to the conduct of all future multipurpose, open-ended space operations. Provision should be made for the planning and timely achievement of such capabilities, including:

The reliable, economical operation of round-trip Shuttle transportation to and from low Earth orbit.

The construction and operation of an evolutionary operations base and laboratory in low Earth orbit, including associated vehicle staging, refueling, and maintenance, dormitory and life-support facilities, physical and medical research laboratories, and space construction capabilities.

The development and deployment of a reliable, economical interorbit transport system for personnel and cargo for reusable transportation between low and geosynchronous Earth orbits, and eventually the Moon.

The later establishment of an orbital base in geosynchronous Earth orbit.

Initial planning for the first research center, resource development laboratory, and refueling station on the Moon.

Vigorous R. & D. programs in supporting technologies, with particular emphasis on robotics, large space structures, solar energy, biology, and Earth and planetary observations.

Third, we should continue to promote international participation in major space ventures as a positive step toward the maintenance of peace among the major powers, toward the future application of space systems to raise living standards around the globe, and toward the sharing of the costs and benefits of space activities among all countries of the world.

I would like to conclude, Mr. Chairman, by observing that a vigorous U.S. space program is essential to meeting what I believe are the four greatest challenges we face today:

First, preserving the peace between the superpowers by persuasion and deterrence;

Second, building, as an example for all the world, a prosperous, multiethnic, free society in America "with brotherhood from sea to shining sea";

Third, applying international science and technology to raise health and living standards while preserving the environment around the world; and

Fourth, continuing the vigorous scientific exploration of our expanding universe, including the propagation of terrestrial life to new worlds.

All of these major challenges involve the space frontier, where mankind's destiny will surely be determined.

Mr. Chairman, that concludes my remarks. I would be happy to respond to any questions that you and the committee may have.

[The prepared statement plus answers to questions asked of Dr. Paine follow:]

Statement of Dr. Thomas O. Paine,
President, Northrop Corporation
Before the
Subcommittee on Space Science
and Applications of the
Committee on Science and Technology
of the
U.S. House of Representatives
July 23, 1980

Mr. Chairman, and members of the Subcommittee, I deeply appreciate the opportunity to appear once again before this Committee. These hearings on U.S. space policy are being held at a critical time for the future of our national space program.

We are on the threshold of a new era in space made possible by the space shuttle. Yet we seem to have lost both our sense of direction and our resolution. The bold, successful, and rewarding space initatives of the 1960s stand in stark contrast to today's irresolution and drift. The policy indecision is clear: rhetoric calling for U.S. leadership in space, accompanied by program cut-backs. To reenergize our space program we must establish promising new long-range goals in science, in technology, and in economic applications. We must initiate reliable, low-cost, shuttle-based transportation to orbit, followed later by a practical, reusable, interorbit and lunar transportation system. We must build permanent research and operating bases in low earth orbit, in geosynchronous orbit, and later on the moon.

Before discussing these long-range proposals, I should note that exactly 11 years ago today--on Wednesday, July 23, 1969--the Apollo 11 astronauts were 116,000 miles from earth in their thirteen ton spacecraft, "Columbia," returning from man's first exploration of the lunar surface. This expedition marked the culmination of an act of American faith and self-confidence which fulfilled President Kennedy's vision that America must become the leading spacefaring nation. The whole world cheered this exploit, recognizing that human intelligence had transported terrestrial life across a quarter of a million miles to initiate travel to other worlds.

The Apollo Era of the 1960s and early 70s was characterized by burgeoning U.S. space initiatives in science, exploration, and application. As a result of our initiatives in the 60s,the 70s saw NASA's far-ranging spacecraft exploring the planets Mercury, Venus, Mars, Jupiter, and Saturn. This November the first of two Voyager spacecraft launched in 1977 will transmit back to earth a more detailed look at Saturn and six of its moons, after which one spacecraft will proceed on out to distant Uranus. In parallel with our exploration of the solar system's six innermost planets and their moons, Skylab astronauts have studied the sun in unprecedented detail, and NASA's Orbiting Astronomical Observatories have been scanning the farthest reaches of the universe using frequencies of light, x-rays, and gamma rays that cannot penetrate the atmosphere to earth-based observatories. Spectacular new cosmological phenomena are under study, from highly energetic quasars that emit unaccountably extravagent energy, to superdense neutron stars and possible black holes that appear to be devouring matter. On the practical side, while new industries are springing up to provide satellite-based services over an ever-broadening spectrum from communications and weather forecasting to navigation and earth resource analysis.

This space activity initiated in the 1960s has generated spectacular new knowledge. From this I believe that our greatest single return has been an enormous widening of man's horizons. In addition to this mind-stretching we have achieved many direct benefits from space-initiated technological advances in such fields as computers, electronics, medicine, manufacturing, agriculture, transportation, energy--and many others. On the geopolitical scale, the new availability of satellite verification has made possible realistic arms control negotiations. On the human scale,people in one hundred nations are now linked together by satellite communications. Indeed, the burgeoning communications satellite industry is providing a vital global communications system that increasingly permeates the social, economic, and governmental elements of our planet. This vigorous new space-age industry, in which the United States is still preeminent, stems directly from our space program. Private enterprise has now raised and invested more than $1 billion in orbiting comsats, with a growth trend that indicates another doubling in the next few years. In similar fashion, satellite remote sensing has grown from small weather satellites to large, multiple application satellites, initiating another new space-age industry with major future implications for agriculture, transportation, mining, cartography, environmental analysis, oceanography, and many other fields.

Thus our space initiatives of the sixties have provided rewarding gains in exploration, science, and applications, but in the seventies caution replaced self-confidence and America's vision of the future degenerated to reduced expectations. We have turned back from the limitless horizons of space to the confining notion of zero growth.

Having lost the momentum of the 60s, we find today a greatly diminished NASA program. As an overall measurement, NASA's budgets of the mid-sixties would exceed $14 billion in today's dollars, in stark contrast to its '81 budget of $5.5 billion. NASA's highly productive science program has been substantially curtailed, with only 3 planetary missions to be launched in this decade, and the content and pace of our solar system exploration program subject to debilitating uncertainty.

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Our most recent national space policy pronouncement calls for U.S. leadership, but states that high-challenge initiatives would not be appropriate at this time, and that decisions concerning needed new directions for our space programs should be deferred until after the space shuttle. Ringing rhetoric proclaiming U.S. leadership in space is no substitute for plans and programs. In my view it is self-delusive to give lip-service to leadership while avoiding initiative and commitment. America faces a clear choice today: Should we reinvigorate our space program, or continue to drift downward? Continuing to coast amounts to a voluntary surrender of leadership in this century's most promising field of exploration.

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Earth orbit is indeed a new continent overlooking the entire earth below to which we are exporting increasing payloads and from which we are importing in return valuable services and data. We should now establish a permanent presence within this new continent to capitalize more rapidly on a myriad of major space opportunities. We know, for instance, that communications satellite services are projected to double in the next few years. Similarly, remote sensing satellites--the weathersats, geosats, landsats, seasats, reconsats, navsats, and others--represent a growing economic requirement for orbital monitoring of earth and space.

The quantitative growth in communications and remote sensing services will be accompanied by qualitative increases in levels of performance and flexibility that must be fitted into the already crowded Geosynchronous Earth Orbit (GEO) slots 23,000 miles above the earth's equator. The inevitable growth patterns in GEO activities vital to our society and our economy calls for better management of increasingly scarce frequencies and orbital slots, supported by increasingly capable space infrastructure in both LEO and GEO. The information and communications environment of orbital space in the future will include large platforms supporting multiple instruments and data handling facilities, large antenna farms, communication switching and multiplexing centers, multi-antenna navigation and tracking stations, all connected by laser beam communication links.

The continued scientific exploration of the universe within and beyond our solar system is also of fundamental importance. There are many advantages in using earth orbit as an operational base in such programs. For instance, our experience with the High Energy Astronomical Observatory (HEAO) and the expectations for the space telescope, demonstrate the need for larger astronomy facilities in orbit--facilities where scientific studies can be done with flexibility in response to targets of opportunity. Similarly, it is clear that in the exploration of the solar system robot spacecraft launched from well-equipped orbital platforms would have substantial advantages in payload and flexibility over those launched from the earth's surface. The assembly, fueling, checkout, launching and docking of both scientific spacecraft and application satellites will be routinely carried out from orbiting bases.

The unique environment provided by the vacuum and weightlessness of space has long been recognized, and initial experiments such as those of Skylab have confirmed the promise of orbiting laboratories. The limited steps that are now being planned for the shuttle and spacelab are too timid, as described by the General Accounting Office. I would commend the NASA/McDonnell-Douglas joint agreement for space R&D, however, as a positive step that may be the first of such arrangements. Indeed, the routine conduct of opportunistic research in laboratories in space is an activity whose time has come. Research and experimentation in medicine, space construction, new materials, solar energy, optics, space manufacturing, robotics, and other disciplines will be continuing activities in space for decades to come. We need to explore new ideas that utilize the availability of unlimited energy, ready sources of lunar and asteroidal materials, and the benign characteristics of weightless, atmosphere-free space. Now is the time to plan and initiate work on the essential initial orbiting bases.

Mr. Chairman, these projections of the nation's future potential in space are not unduly optimistic. They are consistent with our progress over the past two decades, and with our national experience with the application of new technology in other areas. We should recall that forty years after Ford's assembly line, 40 million Americans owned automobiles, and 40 years after Lindbergh's flight, 20,000 people were jetting across the Atlantic every day. We are barely into the Space Age, but already the U.S. has placed 1000 payloads in orbit, including systems and instruments whose capability, sophistication, and accuracy were unheard of a few years ago. We must be realistic, but we must not let our vision and plans for the future be obscured by the myopia and timidity all too prevalent today.

Mr. Chairman, the revitalization of our nation's Civilian Space program is necessary for our national security, for the growth of our economy, for our technical leadership, and for an improved understanding of our universe and its origins. In developing new policies and goals to govern this revitalization, I suggest the following points be considered:

First, we must develop new policy statements that set forth measurable goals and timetables in science, in application, and in the progressive development of the infrastructure needed to support man's presence in space. For example we should schedule the exploration of each planet in the solar system by robot spacecraft, the experimental capture of solar power in orbit and its electrical transmission to earth, the establishment of major radio and optical telescopes in space, the creation and operation of a manned lunar research station, and other long-range goals that can provide policy direction beyond the near term.

Second, we must create certain key capabilities which are critical to the conduct of all future multi-purpose open-ended space operations. Provision should be made for the planning and timely achievement of such capabilities, including:

- The reliable, economical operation of round-trip shuttle transportation to and from Low Earth Orbit (LEO).
- The construction and operation of an evolutionary LEO operations base and orbital laboratory, including associated vehicle staging, refueling and maintenance, dormitory and life support facilities, physical and medical research laboratories, and space construction capabilities.
- The development and deployment of a reliable, economical interorbit transport system for personnel and cargo for reusable transportation between LEO, Geosynchronous Orbit (GEO), and, eventually, the moon.
- The later establishment of an orbital base in GEO.
- Initial planning for the first research center, resource development laboratory, and refueling station on the moon.

Vigorous R&D programs in supporting technologies, with particular emphasis on robotics, solar energy, and earth and space observations.

Third, we should continue to promote international participation in major space ventures as a positive step toward the maintenance of peace among the major powers, toward the further application of space systems to raise living standards around the world, and towards the sharing of the costs and benefits of space activities among all countries of the world.

I would like to conclude, Mr. Chairman, by observing that a vigorous U.S. space program is essential to meeting what I believe are the four greatest challenges we face today:

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Third: Applying international science and technology to raise health and living standards while preserving the environment around the world, and

Fourth: Continuing the vigorous scientific exploration of our expanding universe, including the propagation of terrestrial life to new worlds.

All of these major challenges involve the space frontier, where our destiny will surely be determined.

Mr. Chairman, that concludes my remarks; I would be happy to respond to any questions that you and the committee may have.

RESPONSES TO COMMITTEE QUESTIONS

Dr. T. O. Paine, President - Northrop Corporation

Administrator - NASA, 1968-70

1. Allowing budget pressures associated with the Space Shuttle program to dictate NASA's new programs and goals is bad management based on a policy of short range expediency. To overcome the resultant erosion in U.S. technology isn't possible, so the practice must be stopped. Fortunately the peak funding for Shuttle development is behind us.

   The key to maintaining a healthy institutional base and a growing advanced technology base within NASA is a strong program of space exploration, application, and science. The technology and institutional bases are not ends in themselves; they exist to achieve goals; they thrive only when they are being challenged, and the first requirement for their health is a long-range assignment of future accomplishments and schedules. This, in turn, leads to planning of the time-phased resources necessary to support them properly. These need not, and should not, be forced into a procrustean bed of uniform annual dollars.

2. It is certainly feasible to commit this nation to worthwhile programs, just as it's also possible to avoid initiative, commitment, and challenge while simultaneously proclaiming leadership. The United States is financially and technically capable now of committing to the establishment of a manned multi-purpose, open-ended Space Operating Base and Orbiting Laboratory in this decade, and to the development and operation in this century of a reusable, reliable, economical transportation system for men and cargo from Low Earth Orbit out to Geosynchronous Orbit and the moon. We should initiate these programs now.

3.
and
4. The challenge and importance of exploring, developing, and utilizing space are so great that NASA's charter should not be broadened to include responsibility for meeting other national needs, although NASA should support and contribute to other agencies. Similarly, within its space charter, NASA can be most effective if its role is concentrated on R&D. After the R&D has been accomplished by NASA and economic feasibility demonstrated, operational application of space-based functions should be turned over to the commercial sector or the appropriate federal agencies with substantive expertise. This may involve the invention of new institutions, as with the Comsat Corporation and Intelsat. Judging the correct timing for the hand-off from RDT&E to operations is never easy.

5. NASA's future staffing and numbers and locations of its field centers depend upon decisions on future programs. It would be a great loss if any of NASA's current centers were eliminated in my opinion. I strongly support increasing NASA's technical programs and strength in robotics and biological systems.

6. Appropriate sharing of technology, data and hardware between the civil and military space programs is sound and should not cause undue concerns. We are one society, and it is important that internal barriers be limited to only those necessary, such as military security. This is consistent with our national philosophy that America's defense establishment is part of and not distinct from our society. We must, however, maintain NASA's open non-military character. This is facilitated by appropriate technology transfer between our civilian and defense space efforts.

7. In my opinion the 1958 act does provide an adequate legal basis for the conduct of national civil space activities. It does not, and should not, commit the nation to specific programs or to larger or smaller budgets. These are matters of national policy which should be addressed in broad terms by the administration and Congressional action, thus providing continuity of programs and commitments.

8. No comment.

9. Yes, as discussed in response to previous questions.

10. No comment.

11. The search for extra-terrestrial intelligence is an exciting long-term, task that we are absolutely compelled to pursue. Is it true that, among the hundreds of billions of stars and planets in our galaxy, only our planet earth has been singled out as the home of intelligent life? The discovery of intelligent life in another solar system would be one of mankind's greatest intellectual breakthroughs. If we are not alone, we must discover our neighboring civilizations. This search need not involve high annual budgets, and the technological advances in Radio Astronomy, Communication and Information Sciences promise to be substantial enough alone to justify the program.

Barring a major conflict between the superpowers, space colonization is probably a certainty of the next century. It will evolve naturally from the low-cost, reliable space transportation systems of the 1980s and '90s, the LEO manned base of the'80s, the GEO manned base of the'90s, and the lunar bases at the turn of the century. The multination activities in Antarctica today provide a parallel for the growing occupation of space over the next twenty years.

12. No comment.

13. I don't know.

14. A hiatus in U.S. manned space flight was deliberately planned so resources could be concentrated on the next-generation space transportation system, the Space Shuttle (which, incidentally, will be "peopled," not "manned"). I think this decision was sound, but not the gap in planning. However, the unfortunate hiatus in planetary missions cannot be justified on this basis; this gap is a direct result of our national loss of vision, leadership, and resolution.

With the Shuttle going into operation next year, opening a new era in space, it is high time America got moving again. Your timely hearings should help stimulate this.

15. There is no lack of public interest in and support for a vigorous space program. Indeed, the demonstrated popularity of Star Trek, Close Encounters, and Star Wars (which alone has grossed over $500 million) belies any lack of interest. Meanwhile, next door to the Rayburn Building, attendance at the Smithsonian Aerospace Museum has broken all records for museum attendance around the world; more than thirty million visitors in its first few years. New organizations dedicated to support of a strong national space program are now springing up throughout the country. I sense a new groundswell of popular support, particularly among the young. The American people do not lack interest or understanding; what we lack is leadership.

16. I believe the most important lesson since Apollo is the need for vision, leadership and continuity of commitment. The seventies stand in stark contrast to the sixties here. For the'80s and'90s we need a two-decade long commitment to specific space achievements which are both substantial and open-ended. The remainder of this century should see America and its allies undertaking challenging space ventures that ensure continuing growth in space science, technology, and practical benefits.

17. See response to Question 2.

TPaine

Thomas O. Paine

Mr. FUQUA. Thank you very much, Tom, for a very excellent statement. I think it touched on many of the issues that we have been interested in and concerned about for some time.

Dr. PAINE. Thank you.

Mr. FUQUA. Is it your opinion that NASA as currently funded and structured can fulfill the responsibilities as outlined in its charter of 1958?

Dr. PAINE. Now, Mr. Chairman, I would respectfully submit that NASA is woefully underfunded for this purpose. We are living today on our technical capital from the past. One of the things that I did not testify to, and it should have been in my testimony, is the fact that when you greatly reduce NASA's budgets, when you undertake too few programs, and when even these programs are done on a shoestring, you have a very pernicious effect on the manpower involved.

One of the most important needs that we face in space today is to recruit bright young people, bring them into NASA, and give them the kind of challenge that Mr. Petrone and I had in our day. We are not doing enough to keep the vital flow of talented people going through NASA's programs.

I think that this problem is directly related to the fact that without sound long-range plans, which in turn lead to vigorous continuing programs, we simply cannot attract new people into the program or even hold the talented people that we have.

Mr. FUQUA. You think that may be the major cause of this, rather than the structure or underfunding?

Dr. PAINE. I do not think underfunding is the cause; I think it is the major symptom. I would put the cause down as the lack of vision and leadership which can develop the program structure which would give the White House and the Congress and the American people widely accepted reasons for increasing the budget.

So I think the budget is No. 2; first we need vision and leadership.

Mr. FUQUA. Do you think the charter of NASA needs any changes to reshape it for the 1980's rather than the 1950's or 1960's for which it was initially written?

Dr. PAINE. It certainly would be in order, Mr. Chairman, to review the NASA Charter, which I have not done. When I operated under it 10 years ago, the charter was very broad and very flexible. I think it emphasized the civilian aspects and openness and international cooperation, while setting our course on what I thought were bold and appropriate objectives. Certainly, at the time, I considered it one of the best charters within the Government.

With all of the progress we have made since, perhaps it would be appropriate to review it.

Let me, as a private matter between me and the committee, take a new look at the charter. If I have any comments on the basis of 1980, I will send them to you separately.

Mr. FUQUA. I would appreciate that.

The charter is rather broad and it lends itself to flexibility. Times have changed—as you outlined in your statement—since the early programs, such as communications in deep space and others that you have also alluded to in your statement.

I wonder if maybe the charter is inhibiting the agency from pursuing these goals. However, in saying that, it has been indicated by the administration—and this always happens, it seems, not necessarily with this administration, but with others—that this is just not the time to commit the Nation to a large engineering challenge, such as the Apollo program.

I am wondering when is the right time to do this. Do you have any insight as to how you would review decisions that have been made in light of this?

Dr. PAINE. There is not any optimum time. There is no millennium when suddenly additional Federal funds become available and the press and the public call for their expenditure by NASA. We usually do bold things in a democracy in times of tragedy and setback and concern: It takes a Pearl Harbor.

But I think particularly in space we ought to be able to move forward confidently on positive rather than negative terms. Before we undertake large commitments we should develop generally accepted plans for the future. This is where I believe your committee and its hearings can be of major assistance.

We need to get our best thinkers to look into the future and to select the achievements and schedule to which the United States should aspire in space. Getting this discussion out in the open and calling for more initiative, creativity, and future orientation should encourage attractive programs and broadly accepted new commitments.

First, we need to understand the opportunities and the costs. We need to understand specifically what are the positive results and goals we should aim toward.

The programs I have proposed here would seem to me to be the ones we ought to be debating, examining the time scales and resources that should be allocated and their long-range benefits.

Mr. FUQUA. NASA has changed over the years, even since you were there. There are programs that are becoming more operational and less R. & D. oriented.

Do you think NASA should be performing operational programs, or should they try to spin those off and continue doing the basic R. & D.; or are the operational programs compatible with other R. & D. programs? Do they contribute?

Dr. PAINE. I would submit, Mr. Chairman, this is primarily a question of timing. When an operational program becomes routine, NASA should not continue to be the operating agency. Presumably, there would be another agency in the Government or perhaps a lead agency which could be selected. Certainly the great development we have seen in the communications satellite industry around the world benefited greatly from the institutional handoff from NASA at the appropriate time to a specially created operating entity.

I think we see the same opportunity looming ahead in the field of Earth observations. It is certainly high time to establish an operational system, followed by a handoff in this area. The ability to handoff the weather satellites to the Weather Bureau on a timely basis greatly facilitated space based weather observations.

There is an appropriate time for each handoff. The difficulty is to know when that time is. Now, in the case of communications, I think it was appropriate to handoff the operating part, Mr. Chairman, while at the same time keeping a healthy R. & D. program going within NASA. That, to me, is the flexible and best way to proceed on this.

Mr. Fuqua. With the lessons that were learned in the post-Apollo days, are there any that we should be aware of in the post-Shuttle days, such as the pitfalls or problems or advice?

Dr. Paine. That is a rather general question. I think my response would have to be rather general.

In any large, human enterprise of the type that the space program represents, it is necessary for all of the various contributors to the enterprise to have a commonly shared view of where the enterprise is going. This requires that the White House with the Congress sets the policy for NASA and establishes a widely understood direction.

This has been done effectively by previous Presidents. My own days in NASA were clearly devoted to fulfilling President Kennedy's commitment that Americans would land on the Moon within the decade of the sixties.

President Johnson also played a major role in setting NASA's pace and direction. In establishing the direction for the post-Apollo program, President Nixon played a major role in NASA's successes of the seventies.

We have to look first to the White House for major, overall policy direction. Certainly, this would be strongly influenced at all times by NASA itself, which always has strong and knowledgeable views, and other Federal agencies, particularly the Department of Defense, the National Academy of Science, and other agencies influenced by space.

But as you know, Mr. Chairman, it has historically also been here on Capitol Hill that many fundamental space decisions are made, in concert or even in conflict with the White House. Lawmakers of great stature in both the Senate and the House participating in committee deliberations, such as those you are having today, will certainly go down in history as having had a major influence on America's direction in space.

So I would submit that NASA, the White House, and the Congress must come up with a bold vision of our space future and a mutual resolve to work together, to allow everyone in the space enterprise, both in the United States and overseas, to set their goals accordingly.

If I could make a negative comment, in concluding this subject, it seems to me that program starts and stops, such as we have had in the Tempel 2-Halley's Comet venture, or the solar satellite, or other projects with the Europeans, create overall confusion that makes it impossible to operate an economical program and to sustain project activities over the months and years required for a successful space operation.

Mr. Fuqua. What is your opinion as to the role that NASA should play in meeting our Nation's needs, other than aeronautical and space activities?

Dr. Paine. NASA certainly represents a major, technical resource in diverse fields. I would like to answer your question, Mr. Chairman, with two specific examples of areas where NASA could be playing a much greater role than it is playing.

The first is in the field of energy, where NASA, in order to conduct space operations, has learned a great deal about advanced energy systems, particularly solar energy, the preferred energy in space. NASA is also outstanding in such areas as fuel cells, cryogenics, microwave transmission, hydrogen, and other advanced fields. I do not think that we are calling on NASA to do all of the things which it is capable of doing to help solve our energy problems.

I can understand with the major responsibility given to the Department of Energy that some sharing is required here, but my first answer to your question would be in the field of energy.

The second response would be that NASA has also been required by the very nature of the space environment to move to the forefront of the new science and technology of robotics. When we get the magnificent photographs of Jupiter and Saturn with data coming back over millions of miles in space, we are seeing the most advanced robot systems ever developed for any purpose, performing superbly for many years with zero maintenance under very hostile environments.

The Voyager spacecraft that will send the photographs back from Saturn in November and later from Uranus are designed to operate without human attention for 30 years. These are robots; they have eyes; they have brains, nervous systems, and all of the talents required for their own internal housekeeping and for communicating with us from the far reaches of the solar system.

It would seem to me then that the second field in which NASA should take a much more vigorous role is in advancing the new field of robotics. The ability to develop sensitive optical sensors, which represent eyes, and to link those through computer brains which perceive to actuators, which constitute hands, will become terribly important in the 1990's and the next century for productivity in all fields of human activity.

I would like to see a far more vigorous robotics program in the U.S. Government with NASA taking the lead.

Mr. FUQUA. That has been a field I have been very interested in. It seemed like a catch-22 situation between the Department of Energy and NSF and other agencies. It has been difficult to coordinate and get attention focused in that direction.

I agree. I think NASA has a great deal that it could do, such as optical sensors.

Mr. Winn?

Mr. WINN. Thank you.

I ask this question of nearly every witness that comes before the committee, particularly at the authorization hearings.

Do you think by starting new programs just to satify the desires of the scientist that we get too revved up and hire too many people too quickly and then are forced to lay them off as the program winds down?

Dr. PAINE. That is a very difficult question. I believe that some of these problems are inherent in the space enterprise. I would submit there are two aspects to your question.

One is the fact that as you develop new programs, you bring in new people. At the end of the programs, they should properly be spun off to do something else. I believe the Apollo program is a fine example of marshaling major national resources to accomplish a purpose, and, when that purpose has been accomplished, spinning those people off into new areas, to the great benefit of the other areas.

Even though it is sometimes a traumatic experience, I regard this as normal in space and something not to be shied from. It is inherent in this lively field.

The other aspect to your question is the one where I have more concern, though. This is the turning of programs on and off on the basis of policy uncertainty and unforeseen demands. This is much more corrosive because, when we spend money to develop a capability, then part way through discontinue the work, our resources are largely wasted. Talented people's efforts that have gone into the uncompleted programs were misapplied through poor management.

I would submit that space programs that have ups and downs in the normal course of missions completed are perfectly acceptable. We are sorry that people occasionally have to change their career patterns, but often in the long run, this benefits all.

But we need to avoid the starts and stops which often reflect back to what we discussed this morning: the lack of a sound long-range NASA plan.

Long-range planning is one of the ways to make sure that we avoid the pernicious effects of wasteful starting and stopping.

Mr. **Winn.** Long-range planning is good and necessary, but we have a situation that we are faced with or could be faced with this year, and we have been faced with it before. It is a change in administration.

Now, each new President has his right to have his science advisers. They tell him what part of the program they should go ahead with. Then they cut out others. Some seem to adjust to the transition very well, and others seem to have stammered and stopped and tried to figure out or maybe have taken a longer period of time in deciding what their policy might be.

Thereby, they leave the industry up in the air, not knowing exactly what the next President and his administration are going to require or what they are going to support. Since we have a national election every 4 years, that makes real long-range planning pretty tough. I do not know what we are going to do about that.

There is legislation that has been introduced that will establish a national space policy. I wonder if you would care to comment on whether you think this would contribute to the health of NASA's future?

Dr. **Paine.** I have seen the legislation and discussed it with various people. I think this is like the chairman's question about the charter of NASA, a policy question.

Yes, such a space policy review would indeed be useful, as long as it is drafted in sufficiently broad terms so it does not preclude adapting to changing circumstances.

I would like to comment also on your remarks on the 4-year election process. It seems to me that a long-range NASA plan which everyone understands does afford any new administration an opportunity to take a look at what the current program is as they come into office. They have a clear reference plan from which to change.

I think it is useful even though there will be changes with each administration to have a document which is understood by all the various people involved.

Mr. Winn. Going back to the charter question, we have seen several instances in the last several years where the charter of NASA has been expanded to allow them to apply their expertise in nonspace areas or I should say related areas. But now, for instance, a piece of legislation was introduced that gave NASA the responsibility for all federally sponsored research on automobiles. It is the Harkin Auto R. & D. bill.

What do you think about this type of charter? Some people thought it was pretty far-fetched. I think there was some support lost on that. Some of us did not feel it came within the NASA charter.

Is this destructive or constructive? What are your thoughts on that?

Dr. Paine. It seems to me the exploration of space is such a major challenge of our times and that we are doing so little compared to what ought to be done in space that if many of these side things are added to NASA's responsibilities, it would detract from their basic mission. So to the extent that it represents a diversion and a distraction, I think it has to be looked at very carefully.

Mr. Winn. On a little different subject, NASA has developed, and rightfully so, the reputation in the Federal Government as a can-do agency, although it may be slipping a little bit right now.

What is it that makes NASA seem unique in this regard? Is it the mission assignment? Is it the management philosophy, or is it the people involved, or is it a combination?

Dr. Paine. I think it is a combination. Certainly the publicly announced mission has been a wonderful rallying point, not only dramatic missions such as going to the Moon, which galvanized 400,000 Americans with a common purpose, a common vision and a determination to succeed, but also missions such as aeronautical research. There has been a very good understanding on the part of the NASA centers and the people involved what it was they could accomplish and were committed to achieving.

One of the reasons why your hearings are so important is that we must not lose that fundamental sense of the mission of NASA, which all of the people in NASA and associated industry people must understand. Clear direction has been a very positive force, making NASA, I think, far more fortunate than other Government agencies which have not had that same feeling for their specific goals.

Second, I think that once you get this sort of understanding of a positive mission, it attracts good people. These people, given competent management, which I believe has been a hallmark of NASA, create an outstanding, can-do agency. So NASA has a very proud tradition, indeed.

As we move into the Shuttle era, there will certainly be problems because of the tremendous challenges undertaken to develop the Shuttle, but I believe this program will also turn out to have been a well-run program. It is going to take another year though before we get the answers.

Mr. Winn. Here is a real toughie. Do you think we are misleading the American public and the American taxpayer in regard to the potential of the Shuttle?

Dr. PAINE. I do not believe we are either leading them or misleading them. I think there really is not a great deal of understanding as to what the Shuttle is.

Mr. WINN. Do they know what the Shuttle really is?

Dr. PAINE. It is reusability versus expendability. It is a question of a big, dumb booster versus a smart high technology booster. These are questions which economists can debate until we begin to get the results on the first mission. It will be rather difficult for experts in the field to understand the great potential of the reliable, reusable, shuttle, much less the public.

I am impressed, however, with the general understanding of the public for the promise of space. In a democracy such as ours, we depend on public understanding of Government programs for the support that they need. I think, in general, the public has a good feeling for the future benefits of space.

Sometimes the public is ahead of some of the rest of us in their understanding that in the long run space is tremendously significant to America and to mankind.

Mr. WINN. Let's be very basic about it, we have made a big deal about the Shuttle being transported on the back of a 747. A lot of models are around. They are in our offices and your offices and in various places, museums and libraries. People have heard it would ride on the back of a 747.

It seems we have misled the people. First, we call it a transportation system. Then we tie in the word shuttle, which here is a transportation system, from here to New York and Boston. People begin to think they might ride in the Space Shuttle as if it were an airline operation.

Dr. PAINE. I have heard it said that putting the Shuttle on the back of a 747 is a very expensive way to add three seats to a 747. At the same time, though, you certainly get a tremendous increase in thrust.

But seriously, as the Shuttle begins to fly, it will attract broad press coverage. I think at that time you will see a great increase in public understanding of what the Shuttle is all about, and many of these questions will be answered.

Mr. WINN. I hope you are right. I think because of the slippage that some people sort of lost interest in the Shuttle. It has been quite a while since they saw the Shuttle transported on the back of a 747, but that will all pick up the closer we get to launch.

I am sure the newspaper writers will have feature stories on it, and there will be investigative stories. It will be brought to the attention of the public.

Dr. PAINE. Yes.

Mr. WINN. It is nice having you back. Thank you.

Mr. FUQUA. Go ahead, Mrs. Bouquard.

Mrs. BOUQUARD. Thank you very much.

I want to thank you for being here today and for your testimony and also for the contribution that you have made to our space program.

Dr. PAINE. Thank you.

Mrs. BOUQUARD. I do not think that we can necessarily equate size with superiority. There are indications that perhaps we are losing our role of leadership. I would like for my own clarification if you could briefly comment on this.

Dr. Paine. You are absolutely right. Size is not leadership. I think we see an example of this in the statistics that are being cited today relative to the number of launches that the Soviet Union made in 1979 versus the United States.

The launches that the Soviet Union are making now are not technological advances. They merely reflect a production line that is turning out more and more of the same vehicles that have flown for years, with modest improvements.

In the United States we are making a massive investment in a great leap forward in the Space Shuttle program, creating a whole new era in space transportation. So qualitatively, I think the United States is still doing very well here, and we should always compare ourselves on the qualitative, not quantitative, level.

At the same time, I think when it comes to the number of young people that are being attracted into aerospace and the amount of space research that is going on in major American universities, it is fair to take a look at the quantitative end. And when it comes to the number of planetary mission that we are launching, we get a feeling of high quality but poor quantity.

But I would submit that in space science and applications we really are not progressing as rapidly in the qualitative sense, as well as quantitative, as we are capable of doing or should be doing for a vigorous, challenging, and highly productive space program.

Mrs. Bouquard. I think the chairman is also very interested in this, as well as Mr. Winn, because of the amendment that he sponsored.

Do you think we are allowing the proper incentives for our young people in establishing goals so they would be greatly encouraged, more than they are right now, to enter scientific and engineering careers? Is this one of our shortcomings?

Dr. Paine. I believe this is one of the things we will see as a side benefit of the Shuttle era. When it becomes much less expensive to conduct experiments in orbit, which the Shuttle will make possible, and when it becomes easy for people without astronaut training to fly to laboratories in orbit and conduct research, then many young people can have careers in space R. & D. activities across a broad spectrum, from medical research in orbiting laboratories to Earth observation, and from astronomy to building large structures.

I feel that we are about to see a renaissance of young people moving into space related careers, but this requires a vigorous NASA program. So when someone enters aerospace as a career, they can see that they can work for years and look forward to exciting achievements.

Mrs. Bouquard. One final question. NASA and the administration decided between a Space Shuttle or a space station, but they decided on the Shuttle. Do you believe the needs identified for space stations are still valid? Would you propose a national effort in this area in the near future?

Dr. Paine. Very much so. In my view a major space station is probably the next step in space we should be considering. One of the purposes of developing low-cost, reliable Shuttle transportation to space was to make possible many new programs like the space station, at a reduced overall cost level than with traditional methods of transportation. Yes, I think a bold space station, an orbiting base and laboratory program, needs a great deal of scrutiny at this time.

This represents, in my view, the most desirable of the new initiatives. Not only would this be a good program in itself, but it would lead to positive results in many future areas of space R. & D. and operations.

Mrs. Bouquard. Aren't we a little bit behind the Soviet Union in this area?

Dr. Paine. I would not think so. The work that was done on the Skylab program gave us detailed technical knowledge of the human factors and engineering design parameters that now ought to be factored into an ongoing space station program. I think we are fully prepared to build a major space station, and I think it is the logical follow-on to the Shuttle program.

It will be a long time before the Soviets have the capability here that we have already demonstrated.

Mrs. Bouquard. Thank you very much.

Mr. Winn. I think we ought to do what they do in political campaigns, that is, to editorialize in the news, and every time they see a story coming in from Russia about a space shot, whatever their latest one is, and they go on and on and on, we should remind the people of the world they have not landed a man on the moon yet, and put that paragraph in each of those.

Thank you, Mr. Chairman.

Mr. Fuqua. Very good.

And I thank you, Tom, very much for a very fine statement. We appreciate your taking time to answer our questions. You have been most helpful.

Dr. Paine. Thank you for inviting me.

Mr. Fuqua. Our next witness is Dr. Rocco Petrone, the president and chief executive officer of the National Center for Resource Recovery. He has some experience in the past with NASA.

[The biographical sketch of Dr. Petrone follows:]

National Center for Resource Recovery, Inc.

RESUME

DR. ROCCO A. PETRONE

Dr. Rocco A. Petrone joined the National Center for Resource Recovery, Inc. as its President and Chief Executive Officer on May 1, 1975.

In this position, Dr. Petrone is responsible for the overall planning, coordinating and managing of the Center and the National Center for Resource Recovery Foundation programs. His position provides a channel between government and private industry to assure a continuing exchange of information on efforts to solve the national problem of solid waste disposal.

The National Center, a non-profit research organization supported largely by American industry and labor, was organized in 1970. Since 1972 it has been involved in testing, evaluating and demonstrating unit processes and systems for reclaiming materials and energy values from municipal solid waste for sale and reuse.

Dr. Petrone previously was Associate Administrator of the National Aeronautics and Space Administration with responsibility for the overall planning and management of the Agency's research and development programs.

During his 15 years with NASA--which began while he was still on active duty as an Army lieutenant colonel--Dr. Petrone served in key positions in the development of the U. S. space program. In 1961 he was assigned as Apollo Program Manager at Kennedy Space Center responsible for the planning, development, construction and activation of all launch facilities for the APOLLO Program. When these were completed, Dr. Petrone was designated in July 1966 as Director of Launch Operations for the Kennedy Space Center with responsibility for integration, test, checkout and launch of all space vehicles, culminating in the launch of APOLLO 11 which landed the first men on the surface of the Moon in July 1969. In September 1969 he was named

APOLLO Program Director for NASA in Washington, D. C. with overall responsibility for the direction and management of the remainder of the Apollo Manned Space Flight Program which extended from APOLLO 12 through APOLLO 17. He also was assigned as Program Director for the NASA portion of the U.S./U.S.S.R. Joint Manned Space Flight Mission, Apollo Soyuz Test Project.

Prior to becoming Associate Administrator, he was Director of the Marshall Space Flight Center at Huntsville, Alabama, which was responsible for the development of the SATURN launch vehicles, the SKYLAB flight systems, and the liquid and solid propulsion systems for the SPACE SHUTTLE.

Early in his NASA career, he served as Saturn Project Officer at Kennedy Space Center. His career in rocket development began in 1952 when he participated in the development of the Redstone ballistic missile at the Army's Redstone Arsenal in Huntsville, Alabama.

Dr. Petrone, a native of Amsterdam, New York, graduated from the U. S. Military Academy at West Point in 1946, and retired from the Army after 20 years' service as a lieutenant colonel. He holds master's and professional degrees in mechanical engineering from Massachusetts Institute of Technology, and an honorary Doctorate of Science from Rollins College, Winter Park, Florida.

Dr. Petrone has received the Fifth Space Congress Award of the Canaveral Council of Technical Societies; the National Space Club's Astronautics Engineer Award; the American Astronautical Society's Space Flight Award; and the Louis W. Hill Space Transportation Award. He was awarded the Michelangelo Award in the field of Space Science by the Sons of Columbus of America, Inc.; and Commander, Order of Merit of the Republic of Italy by the Italian Government. He was elected to the National Academy of Engineering in 1975.

STATEMENT OF DR. ROCCO PETRONE, NATIONAL CENTER FOR RESOURCE RECOVERY

Dr. PETRONE. Thank you, Mr. Chairman and members of the committee. It is a pleasure to accept your invitation and testify on the Nation's civilian space effort.

I would like to say at the outset I sincerely believe that hearings of this type are most important to the well-being and the future of our Nation. It is ironic in a way that as we meet here today discussing what the future course of the civilian space program should be that 11 years ago today Apollo 11 was on a firm course returning triumphantly from man's first visit to a neighboring celestial body to a splashdown in the Pacific Ocean.

The glorious success of that time period and the immediate years that followed was the result of over a decade of commitment by the United States to achieve preeminence in the new arena of space flight that the U.S.S.R. had opened so dramatically with the flight of Sputnik in October 1957.

This technological surprise did much to shake the attitudes and beliefs held by many people in our country. Our reaction to that Soviet challenge was typically American. We had been surprised, caught off guard, but we reacted quickly and positively. The Congress passed legislation establishing the National Aeronautics and Space Administration in 1958 to meet that challenge.

The teamwork that followed between the executive and legislative bodies of our Government to choose the programs and courses of action, to commit the financial and material resources required, and to implement and oversee the execution of these programs was a shining example in the history of our Nation.

The challenge was met and the preeminence of the United States in space was established. But while these efforts were underway in the decade of the 1960's, some of us in the program were concerned as to whether or not the fundamental objectives of the space program were truly understood by the American public, as well as some of our leaders. To us these efforts in space flight development and exploration were not aimed just at placing the American flag and footsteps on the Moon or landing a scientific laboratory on Mars, or orbiting remote sensing equipment and meteorological and communication satellites around Earth.

While all of these direct and wonderful benefits and achievements were being accomplished, underlying it all was the demonstration of American spirit and power and determination to become and remain preeminent in space and to assure that as this new frontier unfolded, the United States would be at the forefront and that free men would lead as we sailed on this new ocean of space.

The open manner in which the civilian space program was carried out with full disclosure to the world of all our plans before the missions and findings at their completion will stand as an everlasting testament to the strength of the American system. Here was our Nation, clearly in a race with the challenge having been set by the Soviets who had a big headstart, willing to discharge its efforts in a totally open manner with the rest of the world sharing in our advances, as well as our setbacks, in our triumps as well as our failures.

The manner in which our program was carried out will long be remembered by the rest of the world as a demonstration of the collective will, national strength, and the true power of the American people. When faced with a challenge that caused some leaders in the international world to question whether the power of the United States had ebbed, the depth and breadth and success of the civilian space program in the 1960's and 1970's clearly showed that American growth and power were still in the ascendancy.

As we progressed through the decade of the 1970's, the United States reached a high plateau of achievement and capability in our space endeavors, but was also approaching a crossroad in determining our future course of action in the civilian space program.

After the completion of Apollo, Skylab, Viking, and many other historic ventures in space, there came a need to set new bold targets and goals. What was a necessary transitional pause to evaluate the future speed and direction that the civilian space program should take now is coming dangerously close to a condition of stall and possible loss of minimum momentum that is needed to carry large, complex programs through their critical phases.

I proudly mentioned earlier that 11 years ago today that Apollo 11 was returning from its historic jurney to the Moon. But I must also point out with a great sense of concern that tomorrow marks the fifth anniversary since an American flight crew last traveled in space. That was the completion of the Apollo-Soyuz joint mission with the U.S.S.R.

And while this hiatus in American manned space flight has transpired, the Soviets have continued to extend their capability. Today, as we sit here discussing the future course of the U.S. civilian space program, two Russian cosmonauts are in their fourth month in a space laboratory orbiting Earth 16 times every day, probably on their way to breaking the record of the nearly 6-month manned orbital mission in the same laboratory set by the Soviets within the last year.

The disconcerting fact of this is not only the erosion of our hard-gained leadership in space that we see taking place, but that such little concern is being shown in the media, by the public, and by our leadership at all levels. This is so different from our reaction just 20 years ago to the many Russian firsts in space, such as Sputnik, Lunik, and the orbital flight of Yuri Gargarin.

It may be that there is a belief that since we landed men on the Moon, our leadership in space is unchallengeable, or of even greater concern to me, that leadership in space is no longer of crucial importance to our well-being here on Earth. This reaction is also apparent in other areas, as we see the eroding of our technological base which has been such a source of strength over the years.

There appears to be a growing mistrust in our Nation of large-scale technological endeavors at the very time when such efforts are vitally needed if we are to retain our leadership role in the free world. There is a tendency to demean the very technological genius that is our historic strength and pride.

We are seeing technological timidity in a nation that has been built over the years on technological strength. The continuation of this attitude will assure that the United States will, indeed, lose its tradition of technological leadership. This must be reversed and what must be recognized is the great strength the United States possesses in science and technology and in the talent to mobilize this strength to be applied to national needs.

The civilian space program today is in dire need of a bold central theme for future space goals that can focus support for these goals. The argument is made that there is little, if any, public support for such goals. Then there follows that the lack of such goals is responsible for the indifferent attitude on the part of the public.

This self-defeating circular reasoning must be broken. Herein lies the role that responsible leadership in the Congress, as well as other levels of Government, can play: to articulate the space goals and results so that the role it plays as a leader in the development of new technology, as well as being a bountiful source of new knowledge, can be understood by a public who does not have either the time or the sources to probe the depth of this complex question.

To improve conditions in our society, we need to create more wealth through greater productivity based on new technology. For too long we have drawn down our technology bank and allowed our technology base to erode. Now we must make the investments to add to that bank and to assure that it is not allowed to dissipate and drift downward.

The civilian space program offers a truly superior opportunity to accomplish this by bringing together Government, business, academia, and research institutes in a synergistic relationship that can function in an open forum. At the same time that the space program serves to act as the cutting edge of technology, it also serves to allow man to probe the unknown and to pursue ideas yet untried and to encourage ideas yet to be dreamed.

The future in space is truly limitless and probing this vast frontier can also spur us onward to find new solutions to our age-old problems here on Earth. A survey of the advances and accomplishments of the first two decades of the civilian space program certainly hint at the depth and breadth of the potential that exists:

Communications satellites bringing nations closer together on Earth and interplanetary probes transmitting scientific observations from Jupiter.

Remote sensing satellites observing food crops in Kansas and an orbiting observatory transmitting pictures of the landscape of Mars.

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Man exploring the Moon on a battery-propelled roving vehicle and a remote laboratory on Mars making soil analysis and measuring wind velocities;

Man performing experiments in the weightless environment of an Earth-orbiting laboratory and scientific satellites observing the actions of the Sun.

A list like this could continue for many pages and what would be common to them all is not only the almost science fiction aspects and the 21st century come true today, but the bold decisions made to carry out these programs and the clear indication of the strength and will of our people and our system to commit our resources and prestige to advance not only our capabilities here on Earth, but also to explore the frontiers of knowledge and share them with mankind.

Decisions are needed now in selecting programs and setting goals of the space program for the 1980's and beyond. Program options have been studied and restudied. There will always be reasons for postponing decisions in new space ventures, while we assess domestic problems that affect us daily.

But we must not turn all our attention and thought inward, away from the challenge and opportunities of this new frontier because to do so would be to turn our back on the path man has followed in his journey from the distant past to the civilization we all enjoy today.

On this note, I would like to conclude my remarks on future space goals with a quotation from Robert Browning: "Ah, but a man's reach should exceed his grasp, or what's a heaven for?"

[The prepared statement of Dr. Petrone follows:]

STATEMENT

on

THE NATION'S CIVILIAN SPACE EFFORT

before the

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

COMMITTEE ON SCIENCE & TECHNOLOGY

U. S. HOUSE OF REPRESENTATIVES

by

DR. ROCCO A. PETRONE

NATIONAL CENTER FOR RESOURCE RECOVERY, INC.

23 July 1980

STATEMENT
on
THE NATION'S CIVILIAN SPACE EFFORT
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DR. ROCCO A. PETRONE
NATIONAL CENTER FOR RESOURCE RECOVERY, INC.
23 July 1980

I am Dr. Rocco Petrone, President of the National Center for Resource Recovery, Inc., and am pleased to be able to accept your invitation to testify on our Nation's civilian space effort. Before leaving the National Aeronautics and Space Administration in 1975 to accept my present position with a private, non-profit organization dedicated to advancing the cause and the state-of-the-art of resource recovery from municipal solid waste, I had been involved in the research, development, and operations of guided missiles, rockets, and space craft for twenty-five years, with the period from 1960 to 1975 spent with NASA in various assignments as APOLLO Program Manager and Director of Launch Operations at Cape Kennedy, APOLLO Program Director at NASA Headquarters, Director of the Marshall Space Flight Center in Huntsville, Alabama, and as Associate Administrator at NASA Headquarters in charge of the research and development operations for the space agency.

It is ironic in a way that as we meet here today discussing what the future course of the civilian space program should be that eleven years ago today APOLLO 11 was on a firm course returning triumphantly from man's first visit to a neighboring celestial body to a splashdown in the Pacific Ocean. The glorious success of that time period and the immediate years that followed was the result of over a decade of commitment by the United States to achieve pre-eminence in the new arena of space flight that the USSR had opened so dramatically with the flight of SPUTNIK in October 1957. This technological surprise did much to shake attitudes and beliefs held by many people. Our reaction to that Soviet challenge was typically American -- we had been surprised and caught off guard but we reacted quickly and positively -- the Congress passed legislation establishing the National Aeronautics and Space Administration in 1958 to meet that challenge. The teamwork that followed between the executive and legislative bodies of our government to choose the programs and courses of action, to commit the financial and material resources required, and to implement and oversee the execution of these programs was a shining example in the history of our nation.

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- Man exploring the moon on a battery propelled roving vehicle and a remote laboratory on MARS making soil analysis and measuring wind velocities

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A list like this could continue for many pages and what would be common to them all is not only the almost science fiction aspects and the 21st Century come true today but the bold decisions made to carry out these programs and the clear indication of the strength and will of our people and our system to commit our resources and prestige to advance not only our capabilities here on Earth but also to explore the frontiers of knowledge and share them with mankind.

Decisions are needed now in selecting programs and setting the goals of the space program for the eighties and beyond. Program options have been studied and re-studied. There will always be reasons for postponing decisions in new space ventures while we assess domestic problems that affect us daily. But we must not turn all our attention and thought inward, away from the challenge and opportunities of this new frontier because to do so would be to turn our back on the path man has followed in his journey from the distant past to the civilization we all enjoy today. On this note I would like to conclude my remarks on future space goals with a quotation from Robert Browning:

"Ah, but a man's reach should exceed his grasp,
Or what's a heaven for?"

Mr. FUQUA. Thank you very much for a very inspiring statement. The experience that you have had in NASA up until the last few years, what would be your idea of how NASA's structure and management should be formulated for the goals of the 1980's and in light of the things you outlined in your statement?

Dr. PETRONE. In terms of the structure that exists, I would not have a recommendation, but there is the need for a new, well-identified goal. It has been said around Washington in the midseventies that NASA was an agency looking for a mission. In some ways that may be true.

This tremendous capability had been built up to meet a challenge. There was a combination of many things. Certainly it was the dreams of many years. People joined an organization that had this definite mission as a national commitment put forth before the world, and carry out what had been a dream and literally to develop a technology base that would be unchallenged.

Those elements are still there. The charter you talked about earlier this morning may need some fine tuning, but the beauty of that charter set up in 1958 by the Congress was to go after the potential benefits of the new frontier and to share them openly with the rest of the world and it put our reputation right on the line.

I think those aspects are there and can still be matched. The thing I am worried about is the explanation of the relevance of space, the interpretation of this to our people. It is a very complex issue. That is what is missing.

If the leadership will not undertake to do this, then there is very little that the media can do. They could give it more publicity. I believe it should have more coverage. Why is this being done? What does it mean?

If one looks today at Detroit and Pittsburgh, we are looking at two great strengths of American society in automobiles and in the production of steel. We were leaders in the world; today they are both seeking protection. How did this happen?

It is not a simple case. I know they failed to stay competitive. Maybe we just grow old. The aging process has got to be delayed by the virtue of forcing competition. I look today at the aerospace program where we build the world's best airplanes, and there is a tremendous source of return as to jobs in international sales, but in 10 or 15 years, we may look at Los Angeles and Seattle the way we look today at Pittsburgh and Detroit. I hope not.

There is no guarantee you will stay first. I think the structure is there. It is one of a continuous need to articulate the challenge. It is a continuous need for leadership to interpret this. Because you are on top does not mean you are going to stay there.

I do not have to mention that to the members of the committee. Every 2 years you put your reputation on the line before your constituents. It is the same with our country. It is the same with the various industries. They have to be online to stay sharp.

In doing this, you can develop and you can add to your capability to continue to deliver a mission.

Mr. FUQUA. Do you think that NASA, as currently structured, is equipped to play a major role in space policy decisionmaking?

Dr. Petrone. When you say "structured," I was thinking of the way that they carry out their business.

Mr. Fuqua. The way it is currently equipped.

Dr. Petrone. In terms of playing the role in space policy, well, I think in many ways NASA can only react to questions put to it by the Congress or put to it by the executive branch. It is very difficult for any department to take off too much on a course of its own.

I do believe in hearings like this, in the dialog as one searches, such as: Are we on the right road? Are we going at the right speed? I think it becomes apparent that we are drifting. I think as one looks at the last few years—and I have often referred to our space program as a big flywheel—it is very large but it has a momentum that is very easy to slow down. The flywheel must be kept rotating if you are going to get through the very tight spots. Right now NASA is in a tight spot on the Shuttle. It is going to be carried through by the momentum it has and the people, or it will not get through.

You cannot easily add to it today. Once you are crossing the river, you had better get across if a storm is coming up. I am looking to the years beyond. I see the flywheel coming to a very abrupt slowdown.

Mr. Fuqua. Now, somewhat away from the major thrust of your comments, I talked to Dr. Paine and asked a similar question about the advantages and disadvantages of NASA and their operational programs, and should they be in the private sector or quasi-governmental organizations.

How do you view this from your past experience and outside of Government?

Dr. Petrone. I saw what went on during the spinoff or creation of Comsat. It is a way to take technology that is ready to put it into the free enterprise system and place it into the market. That was a proper step, and it was one articulated in the Halls of the Congress. There were questions whether NASA should keep it and should not keep it, or whether we should monopolize it. The right decisions were made.

If one were to try to apply that today to remote Earth observation, I may disagree somewhat. I am not sure the time is right. Then we could use the communications satellite immediately to make phone calls and transmit television signals. The Earth remote sensing needs more development.

When this is spun off, it should go into those departments or parts of Government or our society that need the tool. NASA cannot keep the tools. They should not keep them to themselves. Now, the Landsat satellite has shown a lot of promise, but the use of that data is not as easy to use as the communications satellites.

It possibly needs I will not say another generation, but I do think it needs additional NASA-type development. It should be spun off eventually to where the Department of Agriculture and the Interior Department or others, with forest, farm, and ocean surveillance needs, would become the operators just as NOAA uses the meteorological satellites.

Once developed, you have something to use and the interpretation of the data belongs in the proper hands for operational purposes. It is a question of timing.

I believe the remote sensing field requires more Government development before it would fall out into the civilian economy. I am saying this on a broad basis. There may be a specific element that is ready today. The broad basis of remote sensing satellites, I believe, needs more R. & D.

Mr. Fuqua. In the last few years we have seen the NASA budget somewhat on a rather constant dollar level. At the same time, we have seen the military space budget increase.

Do you think NASA should take a larger role in the defense oriented programs, say, not in weaponry, but in reconnaissance and in defense communications other than they presently have?

Dr. Petrone. The 1958 charter addressed that—and there was quite a bit of discussion about it at that time as to what the interface should be—but the many internal rivalries led us to be second in space rather than first which we could have been. There was no reason for the word Sputnik to be in our heritage.

I would say if it is a military application that it properly belongs in the hands of the military. You want to develop that. You do not want to do that in an open forum. You cannot share that with the world because clearly your defense will be determined by whomever your adversary may be and what capability he has.

However, space technology does represent power. When we can land on the Moon within 100 yards or 200 yards of where we said we would land with our computers and techniques and technology, there is no question about power and respect for our country and its arsenal. But as a weapon or a technique, when it is used for military purposes, then I think you must of necessity keep that in a secret environment. The interface between NASA and the military and the interplay that was set up on the basis of the 1958 law, I believe was sound.

Mr. Fuqua. Go ahead, Mr. Winn.

Mr. Winn. Thank you.

It is good to have you back before the committee. This seems like old times.

Dr. Petrone. Yes; it does. I am willing to admit it.

Mr. Winn. When we measure the commitment to our space program, I guess we always have to look to the size of the budget. In your opinion, is this a fair measure of the commitment, or is this a necessity?

Dr. Petrone. Probably a necessity and not totally fair. During the Apollo program, what I felt was most important was that we had a national commitment. I felt that the policy being voiced by our leaders and Congress then said that what we were doing is vital to the country. It was necessary to be accomplished in a successful manner.

As a result you develop financial support. Financial support, without the commitment of leadership that it be a national goal, I think, would soon flounder. You have got to have an expression and an interpretation to our people that these dollars are well spent, that what we are doing is important. I am not in a position to judge the priorities or demands on our resources.

During the 1970's we did not follow through with the national policy that space explorations is vital to the future of the United States. We need to have both; money and a national commitment. I think the Apollo program was a success because the people in it believed what they were doing. They had a Nation behind them and a visible commitment. It was carried out with a lot of sacrifice in addition to the expenditure of $20 billion.

Mr. Winn. I think you said it very well, but on the other hand, we hear from time to time half jokingly, that engineers and scientists do not really worry about the budget too much.

Dr. Petrone. I appeared before this committee many times, and here is one engineer that knew that the Congress had to be shown before you approved our appropriations. We had to deserve it, and I hope that we did.

The management people recognize this. They know the country does not have a limitless pot from which you can draw. It has to fit into a test of priorities.

I would just suggest that this priority, which is very difficult to interpret and to understand, be interpreted for our people. The media does not interpret the program. They report it.

What is important is the demonstration of the technology, the developments we have made, and why we were going to do it. But our media in its reporting—and I guess you can say I am being critical—did not interpret this aspect. For people to support something complex, they have got to understand it. I think a better job could be done in helping them understand it.

Mr. Winn. The major reason the space program is influenced more by budget pressure than other programs is that the NASA budget represents a significant portion of the discretionary budget. Do you envision this situation changing, or do you have any suggestions on how to mitigate the effects?

Dr. Petrone. If I could say, and not facetiously, I believe all of our budget is discretionary. We have passed laws to make it otherwise. We can change those laws. I know it is very difficult.

You are saying what is left at the end is a little bit at the top. About the only thing as a Nation that we have to be committed to keep is we have to make sure that we service our national debt or we will go bankrupt. All other things can be addressed. We may have passed a law putting many programs off to the side and do not address these programs every year. Maybe that is something we have to look at again.

I do believe that to say that most of the budget is already committed every year indefinitely is avoiding some very difficult decisions.

Mr. Winn. There are some people who say if we do not balance the budget shortly we will not have to worry about priorities in the military or space programs or the priorities in the social area.

Dr. Petrone. I believe the last year we balanced the budget was the year we landed on the Moon, 1969.

Mr. Winn. Maybe we had better close on that. Thank you.

Mr. Fuqua. Mr. Kramer.

Mr. Kramer. In your opinion, should the Space Shuttle be our No. 1 priority at this time?

Dr. Petrone. At this time, yes; but we must look upon this as a way of getting the mission done. This is what bothers me. The question of getting to space and back as cheap as you can is an important goal. The Space Shuttle addresses this.

It is a question of what will you do when you are there and how much is being applied to that goal. How is that being decided and explained? There is no question today, in my mind, that you have to get to space and return before you can do that. The Shuttle represents this. But the larger question remains as to how do you exploit this capability.

Mr. Kramer. Assuming some success with that initiative and for the future, what do you in terms of prioritizing as to where we ought to be going in future activities, what would you prioritize as our No. 1 objective?

Dr. Petrone. I would put an orbiting space station or a manned laboratory. When we looked at the mission of going to the Moon in 1961, when it was being studied, one of the methods we looked at was an Earth orbit rendezvous operation before going to the Moon. The lunar orbit rendezvous operation was chosen very properly because we had to get there within the decade.

Within those studies we saw that the perfection of techniques to work in Earth orbit would give us such tremendous potential—the fact that 100 miles above us you could be in a vacuum and you could be in a weightless condition to perform experiments that we have not dreamed of yet—we have seen hints of this in the Skylab. I would give that my first priority to allow it to build up as an activity in space from which other ventures could grow in later years.

Mr. Kramer. Is this basically what the Soviets are doing?

Dr. Petrone. I have to believe that. I do not have the insight to foresee their long-range goals. When I see their mission and their goals and how determinedly they have worked on this particular space laboratory, they have doggedly kept at it despite a number of failures. It carries out some of the thoughts we had in the early sixties, such as demonstrating crew exchange, resupply, and other operational activities in Earth orbit. It would be very much a dominant force in the future utilization of space.

Mr. Kramer. Thank you very much.

Mr. Fuqua. I have a follow-on question. There was a recent article in Aviation Week magazine, which indicated that the Russians were proceeding with the Saturn V class vehicle, the large launch capability. This indicates a space station or larger payloads.

How realistic do you think their plans are for their continued dominance in space, and what possibly do you view their objectives to be?

Dr. Petrone. Without commenting on that specific story—and I really am not privy to the information—but I do believe in a sense that the Soviets from really the early sixties have chosen the space frontier as the new arena for competition.

With the program that we choose and what we did in 1969 and the work that went with it on a broad front, this clearly put them temporarily, you might say, in second place. I say "temporarily" because one does not win a race unless one continues racing.

Now, what race am I referring to? It is the race of competition of two societies and ideologies. It is the competition of people and decisionmaking ability. There has been discussion of the need every 4 years in our country of running long campaigns and its affect on our leadership role. I certainly do not recommend that our system be changed.

I do not want it to be. We have worked with this for 200 years. But the question is can we make the long-range decisions that will not let another society jump over us?

If you look at what the Soviets have done in the arena of space—the development of larger boosters—and we know she has worked on those we believe she ran into trouble on one series that we think that she was going to use to go around the Moon. We do not believe the Soviets undertook the development of the capability of landing on the Moon with a man, but we believe she did attempt to develop the flight hardware to go translunar. This was in the 1969 timeframe.

She did land remote laboratories on the Moon. The goal of working to seize the imagination of the world is there.

We now see an orientation by much of the world away from Cape Kennedy and the United States in space activities. This has got to have an effect on our relations around the world. The development by the Soviets of a big booster by no means would surprise me. The development of a large space station or commitment of a mission to the planet Mars would not surprise me.

Now this is what I am trying to address this morning—which is we must continue some objectives that will not allow this country to be caught by surprise the way we were in October 1957 after Sputnik.

The hearings held in the Congress then questioned our educational systems, our structure for decisionmaking and many other basic questions. There were very hot winds that were blowing here in October and November 1957 when Sputnik went up.

The strength of our Nation is not just in bombs and bullets that we must have, but by a society that can make decisions, make them openly and discuss and articulate them and then follow through for the world to see.

During the days of Apollo, we had many visitors, heads of states that came to Cape Kennedy. They were there at the invitation of our President. One of them once remarked how much it meant to his small country that, while we are flying to the Moon, they were able with a small radio to tune in and listen. They could fly with us.

When I think of the world "flying with us," instead of against us, I think that is what we have to aim for if we are going to ever reach the era of peace and cooperation that we are looking for.

Mr. Fuqua. I guess we come back to the chicken and the egg situation of how do we get a significant expression of public support for a space program if we do not have some challenge to enlighten the imagination of the American people and give them something to look forward to and also a challenge to the scientific community.

Dr. Petrone. It is the catch-22 phrase all over again. That is why I believe it is necessary to discuss this as the Congress did in 1958—and there were many hearings on this subject. They focused on the fact the country was falling behind dangerously.

Leadership is the essence of putting your reputation on the table and saying I can prove that is the right thing to do. I know this has risks to it, but the fear of losing does not mean we should not take it on. That is the power of a democracy. Once you mobilize that power, then we go on and do the things we have seen the country do.

Mr. **Fuqua.** Thank you very much for being here today. You always do a very excellent job. Thank you for coming.

Dr. **Petrone.** Thank you for the opportunity, sir. It brought back a lot of fine memories.

Mr. **Fuqua.** We also thank Tom Paine for being here this morning. The meeting will adjourn until tomorrow morning at 10 a.m., in room 2318.

[Whereupon, at 12 noon, the subcommittee adjourned, to reconvene at 10 a.m., July 24, 1980, in room 2318, Rayburn House Office Building.]

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UNITED STATES CIVILIAN SPACE POLICY

THURSDAY, JULY 24, 1980

House of Representatives,
Committee on Science and Technology,
Subcommittee on Space Science and Applications,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10:20 a.m., in room 2318, Rayburn House Office Building, Hon. Don Fuqua, chairman of the subcommittee, presiding.

Mr. Fuqua. The subcommittee will be in order.

This morning, the subcommittee on Space Science and Applications continues hearings on the U.S. civil space policy. Administration witnesses will share their views on the effectiveness of the current administration's policy, and hopefully elaborate on any needed revisions.

Our witnesses include Dr. Frank Press, Director of the President's Office of Science and Technology Policy; Dr. Robert Frosch, the Administrator of NASA; and Dr. Hans Mark, Secretary of the Air Force.

If there are no objections, we will proceed with each witness presenting his statement and hold questions until the end, that is, if that will fit with the schedule of the various witnesses. I think many of them may interlock or have mutual questions for many of you, and there will be mutual answers.

Dr. Press, if you would like to proceed, we will be happy to hear from you this morning.

Dr. Press. Do you think I could get away by 11:15?

Mr. Fuqua. We will certainly try. We understand you have time constraints.

[The biographical sketch of Dr. Press follows:]

BIOGRAPHICAL DATA
FRANK PRESS

Frank Press was born in Brooklyn, New York, on December 4, 1924. His undergraduate work at the College of the City of New York was in physics and geology. He received a master of arts degree in 1946 and a doctor of philosophy in geophysics in 1949 from Columbia University. From 1948 to 1955, Dr. Press served on the faculty of Columbia University, first as an Instructor in Geology and then as an Assistant Professor and Associate Professor of Geology. From 1955 to 1965, he was a Professor of Geophysics at California Institute of Technology. During that time, from 1957, he also served as Director of the Institute's Seismological Laboratory. His most recent academic position was as Chairman of the Department of Earth and Planetary Sciences at the Massachusetts Institute of Technology. His publications include 160 scientific papers in the fields of oceanography, planetary physics, natural resource exploration, regional geophysics, structure of the earth's deep interior, and the mechanism and prediction of earthquakes. He is co-author with R. Siever of the textbook "Earth," widely used in American universities.

Dr. Press was elected to membership in the National Academy of Sciences, and is also a member of the American Academy of Arts and Sciences. He was President of the American Geophysical Union, the Seismological Society of America, and is a member of the Geological Society of America, the Society of Exploration Geophysicists and the Royal Astronomical Society.

Dr. Press has been active in the affairs of the National Academy of Sciences, including membership on the Council, the Commission on Natural Resources, the Geophysical Research Board, and the International Geophysical Year Committee.

Dr. Press' government service includes membership on the President's Science Advisory Committee during the Administration of President Kennedy, membership on the Ramo and Baker Committees which were precursory to the Office of Science and Technology Policy during the Administration of President Ford, and membership on the NASA Lunar and Planetary Missions Board. He was appointed to The National Science Board for the term 1970-1976. He was a member of the Governor's Committee for Atomic Energy in the State of California, and served as consultant to the Department of Defense, the Department of the Interior, the National Aeronautics and Space Administration, the Arms Control and Disarmament Agency, and the Agency for International Development. He was one of the organizers of the International Geophysical Year and a prime mover of the research efforts at earthquake prediction in the United States. He served as a member of the U.S. delegation to the nuclear test ban negotiations in Geneva and Moscow.

Dr. Press has been active in international scientific cooperation as a consultant to UNESCO, as a member of the U.S. delegation to the United Nations Conference on Science and Technology for Underdeveloped Countries, as a participant in the bilateral science agreements with the Soviet Union and Japan, and as Chairman of the Committee on Scholarly Communication with the Peoples Republic of China.

Dr. Press' honors include the Columbia University Medal for Excellence (1959), the California Scientist of the Year Award (1960), Life Magazine - One of the Hundred Most Important Young People in the United States (1962), Distinguished Service Award, Department of the Interior (1971), Gold Medal of the Royal Astronomical Society (1971), Arthur L. Day Medal of The Geological Society of America (1972), and Honorary Doctoral degrees from the University of Notre Dame, the College of the City of New York, the University of Arizona, Rutgers University, the University of Rhode Island, the University of Newcastle, and the University of Maryland.

On March 18, 1977, President Carter nominated Dr. Press to be Director of the Office of Science and Technology Policy in the Executive Office of the President and to serve as Science and Technology Adviser to the President. The nomination was confirmed by the Senate on April 27, 1977 and Dr. Press was sworn into office on June 1, 1977.

Dr. Press is married to the former Billie Kallick of St. Louis, Missouri. They have two children, William Henry Press, who is a Professor of Astronomy at Harvard University, and Mrs. Paula Press Checkoway, a school teacher in Chapel Hill, North Carolina.

June 1, 1980

STATEMENT OF DR. FRANK PRESS, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, THE WHITE HOUSE

Dr. PRESS. Mr. Chairman and members of the subcommittee, I appreciate this opportunity to appear before the Subcommittee on Space Science and Applications. In my appearance before this subcommittee last year, it was our first opportunity to review together the Carter administration's space policy. I made a rather detailed statement on it and pointed to areas where we felt continued study was necessary.

Today, only a little more than 1 year later, I am pleased to report on the accomplishments of this administration's space policy that are essential for a strong and evolving space program in the 1980's. The administration has taken a careful look at the overall national space effort, has articulated in three Presidential directives the framework to guide the activities of the various space sectors and has reiterated its support for the Space Shuttle program, the centerpiece of the American space effort in the 1980's.

We are at an exciting and historic threshold—the Shuttle era. As President Carter has pointed out, the first great era in space is over. The second is about to begin. It will come into its own with the Space Shuttle. However, before we look to the future, I think it is appropriate to take a historical perspective of our space program and review our space policy that existed prior to the critical policy decisions made by this administration.

In recent times, from the mid-1970's, both the NASA and Defense space budgets have grown steadily, NASA at an average annual rate of 7 percent and Defense at an average annual rate of 15 percent. Through this long, stable period of funding for civil space program, it was a period of an increasing accumulation of space achievement. This was undertaken while the Shuttle program was initiated and carried to full-scale development.

In the area of Earth observation and geodesy, a variety of experimental U.S. satellites were developed. In the area of weather observation and navigation, both civilian and Defense satellites were placed into orbit. A dozen U.S. and several joint U.S./foreign scientific satellites were launched. Deep space exploration missions—Helios, Viking, Voyager, and Pioneer Venus—were launched to enhance our knowledge about the Sun, Mars, Jupiter, Saturn, and Venus.

The net result was that by 1977, just prior to development of this Administration's space policy, the United States had arrived at fully operational use of space for communications and weather observations. Initial operational status had been reached for satellite navigation. Proof of concept status in space, based on oceanographic observations had been attained. Satellites for land remote sensing were in advanced experimental status. In most major areas of space research, NASA moved from initial understanding to more detailed investigations. We had completed exploratory missions around the Sun to all of the inner planets, and to the outer planets of Jupiter and Saturn. Moreover, the major hardware components for the Shuttle were at the assembly and test stage.

The basic framework for a Carter administration national space policy was set in May 1978 upon the completion of a National Security Council policy review requested by the President. The emphasis was to resolve potential conflicts and to recommend coherent space principles and national space policy.

Importantly, this review concluded that the current direction set forth in the Space Act of 1958 is well founded. It is a remarkable piece of legislation. Two decades later, this act still provides the framework to guide us into this next space era.

The President's directive in May reaffirmed broad U.S. policy principles that have been overarching objectives through five previous administrations. While I need not reiterate all of them here, President Carter reaffirmed the existing policy of separation of military space systems and the open civil space program. The President's directive, at the same time, provided new guidance on technology transfer, data sharing, and hardware sharing between the civil and military programs. This was to avoid unnecessary duplication and to allow maximum cross-utilization of capabilities. I would like to come back to this point later.

Upon completion of the national space policy review, the President directed the interdepartmental Policy Review Committee (Space), which I chair, to assess the needs of the Nation's civil space program. I might add that the Policy Review Committee (Space) has been used extensively to resolve and make recommendations on all space-related policy issues, from developing U.S. positions for U.N. Outer Space Committee meetings to land satellite remote sensing policy.

The Carter administration's space policy is designed to carry us successfully into the next space era. It is centered in three basic tenets.

First, our space policy will reflect a balanced strategy of applications, science, and technology development. I will describe how this balanced strategy has been borne out in practice.

Second, space activities will be pursued because they can be uniquely or more efficiently accomplished in space. Our space policy is evolutionary rather than centering around a single engineering feat. While our reliance on space will grow as we pursue our national goals, we cannot look at space in isolation. Space is an extension of our environment and should be used when national goals can most efficiently be met there or when other alternatives are denied by technology, geographic, or operational factors.

Third, it is premature to commit at this time to a high challenge, space engineering initiative in the order of complexity of Apollo. As the Shuttle development phases down, we will have added flexibility to consider new space applications and exploration. The President stated that an adequate Federal budget commitment would be made to meet these objectives. As you look at the President's proposed budget, even in this very difficult year, space has come out quite well. The two major new starts—in science, the Gamma Ray Observatory, and in applications, the National Oceanic Satellite System—sustained in the revised fiscal year 1981 budget affirm this point.

In the area of technology development, without question, the Shuttle dominates our technology development effort, and rightly so. It represents one of the most sophisticated technological challenges ever undertaken. The Shuttle will catapult the United States into a new space era. We will have a reusable piloted system with a wide range of capabilities. The Shuttle will provide new opportunities for spacecraft retrieval, for routine manned operations in space, for the assembly of large structures in orbit, and for the first time, the opportunity for experimenting with materials processing in space. The Shuttle is designed to serve all space sectors.

As you well know, the Shuttle development effort has encountered technical problems resulting in delays of the first manned orbital flight. Technical, cost and schedule status of the Shuttle has been the subject of close scrutiny by various review groups within and outside of NASA. I need not reiterate the conclusions; you are well familiar with the details.

I do want to state, however, that steady progress on the Shuttle continues. Customers have reserved all available payload capacity through 1985. Throughout the process, the President has been informed on the Shuttle's progress on a regular basis. He met with NASA Administrator Robert Frosch last year to personally review the status of the program. On completion of this review, he reiterated his full support for the program "because of its integral relationship to our national goals in space science and exploration, commercial space utilization, defense and technological leadership." This commitment is demonstrated in the recently enacted fiscal year 1980 Shuttle supplemental request.

I would like to discuss several major policy decisions in the area of space applications. These decisions and activities to implement them illustrate the President's commitment to space applications.

Since 1972, the United States has conducted experimental civil remote sensing through LANDSAT satellites for resources and environmental monitoring. This program has developed many successful applications and attracted many users. Recognizing this fact, the President issued a directive on civil operational satellite remote sensing in November 1979. This provided the framework within which an operational land satellite remote sensing system could be implemented. It assigned Commerce's National Oceanic and Atmospheric Administration the operational management responsibility for civil operational satellite land remote sensing activities, in addition to ongoing atmospheric and oceanographic responsibilities.

NOAA's first action was to develop a transition plan to move toward operational status. It is my understanding a discussion document dealing with the transition plan—raising the critical issues and options—has been forwarded to this subcommittee. While I do not plan on dwelling on this further, since you have hearings on the subject next week, I believe this Presidential decision represents a giant step toward a goal of both the legislative and executive branches. When you have had time to address the discussion document dealing with the transition plan, I think you will agree it is well conceived. It represents a workable outline for the transition period, yet maintains necessary flexibility.

To investigate further the value of satellite data for monitoring agricultural crop conditions, the President in fiscal year 1980 approved the requests for funding for the Departments of Agriculture, Commerce, NASA, and AID to initiate a 6-year research program in worldwide agriculture production forecasting. It is called AgRISTARS. I am pleased to report that this program is moving along as anticipated. Significant technical results have been achieved, for example, an improved computer classification has been developed for area estimates of small grains, corn and soybeans.

Mr. **Fuqua.** If I might interrupt, we have to run over for a vote. We will be right back, and Mr. Flippo will be back also in a few minutes, and we can resume.

Mr. **Wydler.** I have a different situation, and I will be here if you want me.

Mr. **Fuqua.** Certainly.

Then you may continue. This is the first time Mr. Wydler has been chairman of the subcommittee, and he does not have a quorum.

Mr. **Wydler.** Please continue.

Dr. **Press.** In another decision in October 1978, the President designated the National Telecommunications and Information Administration (NTIA), of the Department of Commerce to assist in market aggregation and possible development of domestic and international public satellite communication services. As you know, communications satellite services, to meet such applications as educational and health services for remote areas, often involve low-volume use. It has drawn little interest from commercial satellite operators. Through this policy, we have stimulated the aggregation of the public service market. But most important, the Government is not competing with the private sector to deliver communications services.

NTIA announced this week four grant awards under a new program to stimulate public service use of satellite communications. In the program's early stages, emphasis will be on television programing for educational and other public service uses. During the 4 years in which the funding is limited, it is expected that the management organizations which develop will operate complete telecommunications systems. Grantees will use the awards as seed money while becoming self-supporting businesses in the development of the first satellite system for national public service use. The four grantees are the Appalachian Community Service Network, Bell and Howell Co., the Public Service Satellite Consortium, and the American Educational Television Network.

U.S. leadership in communications satellite systems was sustained by Government research and development in the sixties. In 1972, it was decided to rely upon the private sector and continued defense programs for advanced satellite communication technology. After reviewing the effects of that decision, the President decided that NASA will again undertake selected communications technology R. & D. projects starting in fiscal year 1980 and fiscal year 1981. This should open new, longer term technological capabilities that will keep us in the lead in this area.

While the President decided to maintain separate satellite weather programs for the civil and defense sectors because of their differing needs at present, future polar orbiting satellite development and procurement will be undertaken by Defense, Commerce, and NASA, to maximize technology sharing and minimize cost.

This is an example of the President's directive to minimize duplication between the civil and military sectors. Furthermore, when ocean observations from space can meet common civil and military data requirements, the President decided that joint civil/military management should be pursued. The National Oceanic Satellite System—NOSS—proposed as a major fiscal year 1981 new start in space applications, meets these common objectives. The objective of NOSS is to develop and demonstrate an operational oceanographic satellite system serving the needs of both the civil and defense communities. The resulting data should contribute to the effectiveness and safety of commerce, industry, and national defense forces on, under and above the surface of the ocean. I might add that this major new start preserves the President's balanced strategy in space science, applications and technology development.

Another area I would like to address is the space science and planetary exploration program. As you are well aware, our priorities at any given time will depend on the promise of science, the availability of the particular technology, and the budgetary situation. The goals of the administration's policy are to:

Continue a vigorous program of planetary exploration to understand the origin and evolution of the solar system;

Utilize the space telescope and free-flying satellites to usher in a new era of astronomy;

Develop a better understanding of the Sun and its interaction with the terrestrial environment;

Utilize the Shuttle and Spacelab to conduct basic research that complements Earth-based life science investigations.

Fiscal year 1981 represented a difficult budget year. The President announced an anti-inflation plan that included reductions throughout the budget. Despite this, no programs were terminated in space science and exploration. In fact, the major ongoing projects, the Galileo mission to Jupiter and the space telescope, were unaffected. The reductions were achieved through some slowing down of ongoing activities, such as the International Solar Polar Mission, which will be delayed from 1983 to 1985. Your support in sustaining this mission was essential to maintaining our international commitments.

Even in this austere budget year, the President's intent to have a balanced strategy in space science, applications and technology development was demonstrated. The fiscal year 1981 revised budget continued the funding for a major new science initiative, the Gamma Ray Observatory. This program will help sustain the United States in a position of leadership in space science and exploration. It will yield scientific dividends of major proportions. Through high resolution gamma ray spectroscopy, we will probe the origin of the elements.

In sum, as we enter into the 1980's, our approach on national programs will be transformed by the advent of the Shuttle. The Shuttle program will dramatically illustrate the advantage that the United States maintains in space technology—in load-carrying capacity, ability to retrieve, repair, and eventually to construct in space. It will move the United States into the era of routine, yet significant, work in space.

This country, I believe, is well prepared to meet the challenges and competition ahead. We can go forward with considerable confidence. The United States is the acknowledged leader in space technology. We intend to maintain that leadership.

[The prepared statement of Dr. Press follows:]

STATEMENT OF DR. FRANK PRESS
DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY
EXECUTIVE OFFICE OF THE PRESIDENT
TO THE
SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS
COMMITTEE ON SCIENCE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

July 24, 1980

MR. CHAIRMAN, MEMBERS OF THE SUBCOMMITTEE:

I appreciate this opportunity to appear before the Subcommittee on Space Science and Applications. In my appearance before this Subcommittee last year, it was our first opportunity to review together the Carter Administration's space policy. I made a rather detailed statement on it and pointed to areas where we felt continued study was necessary. Today, only a little more than a year later, I am pleased to report on the accomplishments of this Administration's space policy that are essential for a strong and evolving space program in the 1980s. The Administration has taken a careful look at the overall national space effort, has articulated in three Presidential Directives the framework to guide the activities of the various space sectors and has reiterated its support for the space shuttle program — the centerpiece of the American space effort in the 1980s.

Background. We are at an exciting and historic threshold — the Shuttle era. As President Carter has pointed out: The first great era in space is over. The second is about to begin. It will come into its own with the space shuttle. However, before we look to the future, I think it is appropriate to take a historical perspective of our space program and review our space policy that existed prior to the critical policy decisions made by this Administration.

In recent times, from the mid-1970s, both the NASA and Defense space budgets have grown steadily; NASA at an average annual rate of seven percent and Defense at an average annual rate of fifteen percent. Through this long stable period of funding for civil space programs it was a period of an increasing accumulation of space achievements. This was undertaken while the Shuttle program was initiated and carried to full scale development. In the area of earth observation and geodesy, a variety of experimental US satellites were developed. In the area of weather observation and navigation, both civilian and Defense satellites were placed into orbit. A dozen US and several joint US/Foreign scientific satellites were launched. Deep space exploration missions (Helios, Viking, Voyager, and Pioneer Venus) were launched to enhance our knowledge about the Sun, Mars, Jupiter, Saturn and Venus.

The net result was that by 1977, just prior to development of this Administration's space policy, the US had arrived at fully operational use of space for communications and weather observations. Initial operational status had been reached for satellite navigation. Proof of concept status in space — based oceanographic observations had been attained. Satellites for land remote sensing were in advanced experimental status. In most major areas of space research, NASA moved from initial understanding to more detailed investigations. We had completed exploratory missions around the Sun, to all of the inner planets, and to the outer planets of Jupiter and Saturn. However, the major hardware components for the Shuttle were at the assembly and test stage.

Administration's Policy. The basic framework for a Carter Administration national space policy was set in May 1978 upon the completion of a National

Security Council policy review requested by the President. The emphasis was to resolve potential conflicts and to recommend coherent space principles and national space policy. Importantly, this review concluded that the current direction set forth in the Space Act of 1958 is well founded. It is a remarkable piece of legislation. Two decades later, this Act still provides the framework to guide us into this next era in space.

The President's directive in May reaffirmed broad US policy principles that have been overarching objectives through five previous Administrations. While I need not reiterate all of them here, President Carter reaffirmed the existing policy of separation of military space systems and the open civil space program. The President's directive, at the same time, provided new guidance on technology transfer, data sharing, and hardware sharing between the civil and military programs. This was to avoid unnecessary duplication and to allow maximum cross-utilization of capabilities. I would like to come back to this point later.

Upon completion of the national space policy review, the President directed the Interdepartmental Policy Review Committee (Space) — which I chair — to assess the needs of the nation's civil space program. I might add that the Policy Review Committee (Space) has been used extensively to resolve and make recommendations on all space related policy issues — from developing US positions for the UN Outer Space Committee to land satellite remote sensing policy. The Carter Administration's space policy is designed to carry us successfully into the next era in space. It is centered in three basic tenets:

First, our space policy will reflect a balanced strategy of applications, science, and technology development. I will describe how this balanced strategy has been born-out in practice.

Second, space activities will be pursued because they can be uniquely or more efficiently accomplished in space. Our space policy is evolutionary rather than centering around a single engineering feat. While our reliance on space will grow as we pursue our national goals, we cannot look at space in isolation. Space is an extension of our environment and should be used when national goals can most efficiently be met there or when other alternatives are denied by technology, geographic or operational factors.

Third, it is premature to commit again to a high challenge, space engineering initiative in the order of complexity of Apollo. However, as the Shuttle development phases down, we will have added flexibility to consider new space applications and exploration. The President stated that an adequate Federal budget commitment would be made. As you look at the President's proposed budget — even in this very difficult year — space has come out quite well. The two major new starts — in science the Gamma Ray Observatory and in applications the National Oceanic Satellite System — sustained in the Revised FY 1981 Budget affirm this point.

Technology Development. Without question, the Shuttle Transportation System dominates our technology development effort and rightly so. It represents only the most sophisticated technological challenges were undertaken. The Shuttle will catapult the US into a new era in space. We will have a reusable piloted system with a wide range of capabilities. The Shuttle will provide new opportunities for spacecraft retrieval; for routine manned operations in space; for the assembly of large structures in orbit; and for the first time, the opportunity for experimenting with materials processing in space. The Shuttle is designed to serve all space sectors.

As you well know, the Shuttle development effort has encountered technical problems resulting in delays for the first manned orbital flight. Technical, cost and schedule status of the Shuttle has been the subject of close scrutiny by various review groups within and outside of NASA. I need not reiterate the conclusions; you are well familiar with the details. I do want to state, however, that steady progress on the Shuttle continues. Customers have reserved all available payload capacity through 1985. Throughout the process the President has been informed on the Shuttle's progress on a regular basis. He met with NASA Administrator Robert Frosch late last year to personally review the status of the program. On completion of this review, he reiterated his full support for the program "because of its integral relationship to our national goals in space science and exploration, commerical space utilization, defense and technological leadership." This commitment is demonstrated in the recently enacted FY 1980 Shuttle Supplement Request.

Space Applications. I would like to discuss several major policy decisions in the area of space applications. These decisions and activities to implement them illustrate the President's commitment to space applications.

Since 1972, the US has conducted experimental civil remote sensing through LANDSAT satellites for resources and environmental monitoring. This program has developed many successful applications and attracted many users. Recognizing this fact, the President issued a directive on civil operational satellite remote sensing in November 1979. This provided the framework within which an operational land satellite remote sensing system could be implemented and assigned Commerce's National Oceanic and Atmospheric Administration (NOAA) the operational management responsibility for civil operational satellite land remote sensing activities in addition to its ongoing atmospheric and oceanographic responsibilities. NOAA's first actions was to develop a transition plan to move toward operational status. This plan has been completed. It is my understanding a discussion document dealing with the transition plan, raising the critical issues and options has been forwarded to this subcommittee. While I don't plan on dwelling on this further, since you have hearings on the subject next week, I believe this Presidential decision represents a giant step toward a goal that both the Legislative and Executive Branches have worked toward for some time. When you have had time to address the discussion document dealing with the transition plan, I think you will agree it is well conceived and documented. It represents a workable outline for the transition period, yet maintains necessary flexibility.

To investigate further the value of satellite data for monitoring agricultural crop conditions, the President in FY 1980 approved the requests for funding for the Departments of Agriculture, Commerce, NASA and AID to initiate a six-year research program in worldwide agriculture production forecasting. It is called AgRISTARS. I am pleased to report that this program is moving along as anticipated. Significant technical results have been achieved, e.g., an improved computer classification has been developed for area estimates of small grains, corn and soybeans.

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NTIA announced this week four grant awards under a new program to stimulate public service use of satellite communications. In the program's early stages, emphasis will be on television programming for educational and other public service uses. During the four years to which the funding is limited, it is expected that the management organizations which develop will operate complete telecommunications systems. Grantees will use the awards as seed money while becoming self-supporting businesses in the development of the first satellite system for national public service use. The four grantees are: The Appalachian Community Service Network, Bell and Howell Company, the Public Service Satellite Consortium and the American Educational Television Network.

United States leadership in communications satellite systems was sustained by government research and development in the 1960s. In 1972 it was decided to rely upon the private sector and continued Defense programs for advanced satellite communication technology. After reviewing the effects of that decision, the President decided that NASA will again undertake selected communications technology R&D projects starting in FY 1980 and FY 1981. This should open new longer-term technological capabilities, that will keep us in the lead in this area.

While the President decided to maintain separate satellite weather programs for the civil and defense sectors because of their differing needs at present, future polar orbiting satellite development and procurement will be undertaken by Defense, Commerce and NASA to maximize technology sharing and minimize cost. This is an example of the President's directive to minimize duplication between the civil and military sectors. Furthermore, when ocean observations from space can meet common civil and military data requirements, the President decided that joint civil/military management should be pursued. The National Oceanic Satellite System (NOSS) — proposed as a major FY 1981 new start in space applications — meets these common objectives. The objective of NOSS is to develop and demonstrate an operational oceanographic satellite system serving the needs of both the civil and defense communities. The resulting data should contribute to the effectiveness and safety of commerce, industry, and national defense forces on, under and above the surface of the ocean. I might add that this major new start preserves the President's balanced strategy in space science, applications and technology development.

Space Science and Exploration. Another area I would like to address is the space science and planetary exploration program. As you are well aware, our priorities at any given time will depend on the promise of science, the availability of the particular technology and the budgetary situation. The goals of the Administration's policy are to:

— Continue a vigorous program of planetary exploration to understand the origin and evolution of the solar system.

— Utilize the space telescope and free-flying satellites to usher in a new era of astronomy.

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Even in this austere budget year, the President's intent to have a balanced strategy in space science, applications and technology development was demonstrated. The FY 1981 revised budget continued the funding for a major new science initiative — the Gamma Ray Observatory. This program will help sustain the US in a position of leadership in space science and exploration and will yield scientific dividends of major proportions. Through high resolution gamma-ray spectroscopy, we will probe the origin of the elements.

In sum, as we enter into the 1980s, our approach on national programs will be transformed by the advent of the Shuttle. The Shuttle program will dramatically illustrate the advantage that the US maintains in space technology — in load carrying capacity, ability to retrieve, repair and eventually to construct in space. It will move the US into the era of routine, yet significant, work in space. This country, I believe, is well prepared to meet the challenges and competition ahead. We can go forward with considerable confidence. The United States is the acknowledged leader in space technology. We intend to maintain that leadership.

Mr. Flippo [presiding]. Thank you very much.

I believe we would like to have all of the gentlemen present their testimony. Then we will come to the questions.

Mr. Wydler. I will have a problem because I have to leave to testify before another committee myself. I would like to, if I could, ask one question.

Mr. Flippo. Yes.

Mr. Wydler. This statement troubles me, and I guess the question really comes down to this. Is there anything new in the administration's policy that you have described?

It strikes me that essentially the policy is to carry on the programs that were previously initiated and maybe carry them to the next step in certain phases. Is there anything innovative or new or exciting about the program? Maybe I am missing something, but that is how it struck me as you described the administration's program.

Dr. Press. Congressman Wydler, I think in my testimony I tried to portray continuity of our space program over the five previous administrations and the current one. In that sense, our space program is nonpartisan. It is a national effort. We are all dedicated to it.

I think there are certain new things that we have developed. We have a national space program—the civil and military sectors. We try to remove potential conflicts and to have technology sharing and cost savings so that we have more funds to do other things.

For the first time we have cooperative funding between agencies in the space program. The Agristars program involves five different Government agencies, indicating the space program has grown through a national effort with many different mission agencies involved. Moreover, the NOSS project involves the civil and the defense sectors with cooperative funding. This enables us to do more in space.

The new starts that we proposed represents new scientific opportunities such as in gamma-ray spectroscopy. It's a quantum leap into new technology to explore the cosmos. I think these do represent continuity with the past, but also in seizing new opportunities.

Our commitment to the Shuttle is an enormous one, demonstrated through funding. We are dedicated to seeing this extremely important program through to completion. It is true that the Shuttle program originated in a previous administration. Problems have accumulated over the years. This administration has had to address them.

We should not underestimate the fact that with this transportation system, no country or combination of countries can touch the United States in its ability to work in space with the advent of the Shuttle. I think we should not shortchange or make little of what we are doing in space. We have an expansive program to maintain, and we will maintain our leadership.

Mr. Wydler. I will tell you straight out what bothers me. I get the same feeling here that I get with many other programs, particularly R. & D. and basic science-type programs. Although we hear a lot about the importance, I get the continuing feeling we are living off the past.

The past can only carry us so far. The decisions that were made previously and that we are trying to build on today are important, but what will be there to build on 10 years from now? That is what I keep asking myself.

You are living today off decisions that were made 10 years ago. That is all well and good, but I wonder what the situation will be in the late 1980's for our country. We will have no new programs to live off, and the old programs will have been developed.

I see that not only in the space program, but I see that in military programs in our country and other programs as well. That is what truly bothers me.

I know from the point of view of just looking at it this year, that is fine. But what is going to be there 10 years from today with what the administration has done? I think that is what is lacking in the current thinking going on in this administration.

Dr. **Press.** I have a more optimistic view. I think the Shuttle will enable us to launch satellites and space systems of the kind that are unparalleled in terms of the weight of what we can launch into orbit or into space, and in terms of our ability to construct such things as larger antennas in space. Also this would be in terms of military defense systems, which Dr. Mark will talk about, which will be extremely important to our national security. We could not do these things without the space transportation system.

It does not bother me that it was conceived 10 years ago; it is a national program. The applications of the Shuttle in science will be new, the Shuttle will introduce exciting applications with all sorts of possibilities. I think 10 years from now our space program will be as dramatic as at any time in the past.

Mr. **Flippo.** Will you yield?

Mr. **Wydler.** Yes.

Mr. **Flippo.** Dr. Press, why can't we spell out our goals like those that you mentioned in terms of structures in space? Why can't we enunciate what those goals are instead of backing into it?

Dr. **Press.** I thought we had been doing that. Perhaps not well enough. I think in the policy decisions we have made and as we have described them to you, if you read those documents and everything I have said, you will find that we have done this. If we have not publicized them enough or disseminated them enough, perhaps that is our fault. They are there; they do guide our thinking. What I described to you briefly represents our policy.

Mr. **Flippo.** Thank you.

I recognize the gentleman from New York.

Mr. **Wydler.** Thank you. That is all I have.

Mr. **Flippo.** You may present your testimony at this time, Dr. Frosch.

[The biographical sketch of Dr. Frosch follows:]

National Aeronautics and
Space Administration

Washington, D.C.
20546

Biographical Data

DR. ROBERT A. FROSCH
Administrator, NASA

Dr. Robert A. Frosch was nominated by the President May 23, 1977, to become Administrator of the National Aeronautics and Space Administration. He is the fifth man to head the nation's civilian space agency. Dr. Frosch took his oath as head of the agency and entered the new post June 21, 1977.

Until he was chosen to head NASA, he was Associate Director for Applied Oceanography at Woods Hole Oceanographic Institution from 1975, continuing in that position until mid-1977.

From 1966 to 1973 Dr. Frosch was Assistant Secretary of the Navy for research and development. He served as Assistant Executive Director of the United Nations Environment Program from 1973 until 1975.

From 1963 to 1965 Dr. Frosch was director of nuclear test detection at the Defense Department's Advanced Research Projects Agency (ARPA) and from 1965 to 1966 he was Deputy Director of ARPA.

He was born May 22, 1928 in New York City. He earned a B. A. degree in 1947, M.A. degree in 1949 and a Ph.D. in 1952 in theoretical physics, all from Columbia University.

While completing his studies for the doctorate, he joined Columbia's Hudson Laboratories in 1951, working on naval research projects as a research scientist. He became Director of Hudson Laboratories in 1956, remaining in that post until 1963.

Since 1969 he served as Department of Defense member of the Committee for Policy Review of the National Council on Marine Resources and Engineering Development. In 1967 and 1970 he was chairman of the U.S. delegation to the Intergovernmental Oceanographic Commission meetings at UNESCO in Paris. He received the Arthur S. Flemming Award in 1966 and the Navy Distinguished Public Service award in 1969. He is a member of Phi Beta Kappa and Sigma Xi honorary fraternities. He is a fellow of the American Association for the Advancement of Science, the Acoustical Society of America and the Institute of Electrical and Electronics Engineers (IEEE). His memberships in professional societies include: American Physical Society, Seismological Society of America, Marine Technology Society, Society of Naval Architects and Marine Engineers, Society of Exploration Geophysicists, and the American Geophysical Union.

He is married to the former Jessica Rachael Denerstein of Brooklyn, N.Y. They are the parents of two teenage daughters.

August 1977

STATEMENT OF DR. ROBERT A. FROSCH, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. FROSCH. Thank you for the opportunity to appear here this morning to discuss space policy. More and more, space is becoming a place to work, an extension of our environment. So a discussion of our policy seems timely.

I would first like to review briefly the historical and current context in which we discuss space policy today, and then talk a bit about NASA's role and mission.

The legislative charter for NASA was set in 1958 when Congress enacted the National Aeronautics and Space Act, Public Law 85-568. The Space Act articulated a set of goals which have guided us for over 20 years and which were reaffirmed by the administration in 1978.

Let me review with you the objectives set forth in the 1958 law:

(1) The expansion of human knowledge of phenomena in the atmosphere and space;

(2) The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;

(3) The development and operation of vehicles capable of carrying instruments, equipment, supplies, and living organisms through space;

(4) The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes;

(5) The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere;

(6) The making available to agencies directly concerned with national defense of discoveries that have military value or significance, * * *

(7) Cooperation by the United States with other nations and groups of nations in work done pursuant to this act and in the peaceful application of the results thereof; and

(8) The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States in order to avoid unnecessary duplication of effort, facilities, and equipment.

It is important to note that the 1958 act declares that the well-being of the country requires that provision should be made for aeronautical and space activities and that these activities should be the responsibility of a civilian agency, except those activites primarily associated with national defense which should be directed by the Department of Defense.

Two decades later, after considerable experience with both manned and unmanned spacecraft, and with the Nation on the threshold of a new era in space, the administration asked the National Security Council's Policy Review Committee to formulate principles to guide the Nation's space activities. The Policy Review Committee affirmed the validity of direction provided by the Space Act of 1958.

Although Dr. Press will discuss in full the administration's policy for space activities, let me mention several elements within the administration's policy framework that are of particular importance: The United States will retain scientific and technological leadership in space for the security and welfare of the Nation.

Activities will be pursued in space when it appears that national objectives can most efficiently be met through space activities. We work in space not because it is there or because others do so. We work in space because it is useful to do so.

Our programs in space will reflect a balanced strategy of applications, science and technology development. Let me add that the administration's proposals to Congress on space have reflected this strategy. During times when the overall fiscal picture has required austere budgeting, the administration has supported new initiatives in space, as well as ongoing activities in all of NASA's major program areas.

We will complete the Shuttle and take advantage of the flexibility offered by the space transportation system. Moreover, incremental improvements to the Shuttle will be accommodated as they become necessary. The President is committed to the space transportation system. He fully recognizes the value of routine, economical access to Earth orbit, as well as the need for the development of technologies that can enhance the benefits of our activities in space. The space transportation system will form the basis around which these activities will be centered during the 1980's.

In space science, the policy endorses continued exploration of the planets, exploring the far reaches of the universe, and examining the special relationship between the Earth and the Sun. Current space science activities can be fully supported and we will continue to plan new missions for future consideration.

In applications, the policy supports an operational land remote sensing system; and, with NOAA and the Department of Defense, we are developing for operational test a similar system for the oceans, as well as work in advanced communications technologies and in materials processing in space.

The Space Act and the administration's directives support U.S. leadership in space. After the success of Sputnik in 1958, the United States embarked upon a space program that led ultimately to our placing men on the Moon. This program, rich in science and the spinoff of technologies, was by the early seventies preeminent. Yet this U.S. leadership no longer goes unchallenged. The Russians now have in orbit a manned space station and have repeatedly demonstrated their ability to replenish the station with both manned and unmanned spacecraft. The Western Europeans, the Japanese, and the Chinese are developing their own launch vehicles. The French have decided to develop domestically their own remote sensing system. Communications satellites of the highest quality are being built abroad. The Soviet Union has had an active, strong program in space sciences for many years. The growing capability of Western Europe in space science was highlighted recently by ESA's announcement of a mission to Halley's Comet which does not require the United States as a partner.

Key to implementation of the Nation's space policy in the decade ahead is the Space Shuttle. This unique vehicle, once it is in operation, will enable us to function in space in a routine, versatile, and economical manner. Currently, as this subcommittee knows, Shuttle flights are booked well into 1985.

The Shuttle manifest demonstrates the range of users of space: Civilian Federal agencies, commercial interests, and the national security community. Our policy provides that the different sectors, as appropriate, manage their own activities in space. Coordinating among users is a continuing requirement. My own view is that at present such coordination is achieved and that the Nation is well served by the various formal and informal channels that currently exist.

For NASA and the Nation, the next few years are critical. We must fly the Shuttle and make its operation routine. We must continue to demonstrate the utility of functioning in space, and work to reduce the cost. We must insure the institutional vitality of NASA and, as resources permit, embark upon new missions.

We must recognize, but not overreact to, the challenge to our vision and technology represented by the space programs of the Soviet Union, Europe, and Japan. Finally, we must remember that our successes of the past two decades in space have not been achieved without investment and risk.

The U.S. policy of engaging in international cooperative ventures in space has worked well, in large part because our approach has been from a position of strength, rather than dependence. International involvement is a mark of leadership and is an essential element of a sound national space policy. A nation which loses its vitality is both a less attractive partner and a less effective competitor.

In a real sense, one key to the implementation of space policy is NASA's research and technology base, in terms of both people and facilities. This base, a national resource of unique capabilities, made possible our program successes of the past and is essential to the retention of leadership in the future.

As the subcommittee knows, new initiatives for NASA are critical. Without them, there is no future. The Gamma Ray Observatory—GRO—and the National Oceanic Satellite System—NOSS—proposed by the President as new starts in fiscal year 1981, are important initiatives, and we are gratified that this subcommittee gave GRO and NOSS full support.

NASA's high-technology capability is properly tapped in the interest of urgent national needs. For example, we are involved—in cooperation with the Department of Energy—in developing fuel-efficient automobiles and in building wind turbines. There is a synergism between energy research and the agency's R. & D. that works for the benefit of both programs and ultimately for us all.

The space policy outlined in the National Aeronautics and Space Act of 1958 and reaffirmed by the administration provides a useful policy framework in which to carry out these tasks. The job now for both us and the Congress is to insure that the tasks are accomplished.

Mr. Chairman, that concludes my prepared statement. I will try to answer any questions that you and the other members of the subcommittee may have.

[The prepared statement, plus questions and answers for the record of Dr. Frosch follows:]

HOLD FOR RELEASE UNTIL
PRESENTED BY WITNESS
July 26, 1980

Statement of

Robert A. Frosch
Administrator

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Before the

Subcommittee on Space Science and Applications
Committee on Science and Technology

House of Representatives

Mr. Chairman and Members of the Subcommittee:

Thank you for the opportunity to appear here this morning to discuss space policy. The utilization of space is important to the United States. More and more, space is becoming a place to work, an extension of our environment. So a discussion of our policy seems timely.

I would like first to review briefly the historical and current context in which we discuss space policy today, and then talk a bit about NASA's role and mission.

The legislative charter for NASA was set in 1958 when Congress enacted the National Aeronautics and Space Act, P.L. 85-568. The Space Act articulated a set of goals which have guided us for over twenty years and which were re-affirmed by the Administration in 1978. Let me review with you the objectives set forth in the 1958 law:

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It is important to note that the 1958 Act declares that the well-being of the country requires that provision should be made for aeronautical and space activities and that these activities should be the responsibility of a civilian agency, except those activities primarily associated with national defense which should be directed by the Department of Defense.

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- our programs in space will reflect a balanced strategy of applications, science and technology development. Let me add that the Administration's proposals to Congress on space have reflected this strategy. During times when the overall fiscal picture has required austere budgeting, the Administration has supported new initiatives in space as well as ongoing activities in all of NASA's major program areas;
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System. Moreover, incremental improvements to the Shuttle will be accommodated as they become necessary. The President is committed to the Space Transportation System. He fully recognizes the value of routine, economical access to earth orbit as well as the need for the development of technologies that can enhance the benefits of our activities in space. The Space Transportation System will form the basis around which these activities will be centered during the 1980's;

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Mr. Chairman, that concludes my prepared statement. I will try to answer any questions that you and the other Members of the Subcommittee may have.

RESPONSES TO WRITTEN QUESTIONS FROM CHAIRMAN FUQUA DURING THE HEARING BEFORE THE SUBCOMMITTEE ON JULY 24, 1980, AT WHICH DR. FROSCH TESTIFIED.

QUESTION 1

New programs and goals are being dictated by year-to-year budget pressures and funding problems with the Space Shuttle.

a. What can be done to overcome the resultant erosion of our technology base and capability?

b. Is NASA proposing enough new programs to justify maintaining a healthy institutional base?

ANSWER 1

a. We need as a Nation to be sure to apply appropriate levels of resources to capitalize on technological opportunities in aeronautics, in space, in other high technology sectors.

b. I believe so, although we do not propose them with that as the principal purpose.

QUESTION 2

One tenet of the Administrator's space policy states: "It is neither feasible nor necessary at this time to commit the United States to a high-challenge space engineering initiative comparable to Apollo."

a. Do you agree with this statement?

b. What do you consider to be appropriate long-term goals for NASA to undertake after completion of the Space Shuttle?

ANSWER 2

Yes, I do agree at this time we do not need an Apollo-like initiative. My personal view is that we should be looking toward a significant national commitment to a major engineering initiative within the next three years. Candidates would include full exploitation of the STS, intensive unmanned in-situ planetary exploration, space power systems, permanent space occupancy, perhaps extending to geosynchronous orbit and applications data systems.

QUESTION 3

Should NASA's charter be broadened to include a greater role in dealing with other national needs such as energy?

ANSWER 3

NASA's legislative charter has been selectively amended to include various potentially expanded research roles. However, I believe we need to be careful not to dilute our focus upon aeronautical and space activities.

QUESTION 4

Should NASA perform research and development only, while avoiding operational responsibilities?

ANSWER 4

The Space Act and its legislative history are relatively clear on this point: when true space operations begin to dominate the scene, it will be time to consider whether an entity other than NASA should be responsible (as has been done in the case of civil remote sensing satellites).

QUESTION 5

Is NASA appropriately staffed and does it have the appropriate number of field centers for its projected role?

ANSWER 5

Yes, current staff of NASA is adequate. However, further reductions would have a serious negative impact upon our ability to perform our tasks.

QUESTION 6

What concerns, if any, are raised by the President's directive providing new guidance directing technology transfer, data sharing, and hardware sharing between the civil and military programs?

ANSWER 6

The recent Presidential policy on space codified in directive form what is called out in the Space Act and has been underway since the earliest days of the space program. The civil and military communities have been sharing and exchanging technology, data, hardware, personnel, and facilities as appropriate for years. The success of this activity is measured basically in the absence of duplication and in the breadth of the national technology base. The Shuttle itself is a major example of cross-servicing between sectors. Opportunities for sharing and cross-service, of course, vary with program requirements and the breadth of technological advances being pursued in both sectors. The recent policy statement spurred renewed efforts in these areas.

QUESTION 7

Does the National Aeronautics and Space Act of 1958 provide an adequate charter for civil space activities?

Is there a need to reaffirm the Nation's leadership in exploring and developing the space environment for the benefit of mankind?

ANSWER 7

In general, the Space Act appears quite adequate as a charter for current and immediately foreseeable civil space programs. Relatively minor changes have been required over the years, but the basic charter has remained sound.

QUESTION 8

While NASA's eroded budget is barely holding its own against inflation, the DOD's space budget in accelerating.

a. Is the Nation pursuing a proper balance between the civilian and military aspects of the Nation's space program?

ANSWER 8

Given the total Federal resources that can be dedicated to space are severely limited, the relative proportions being invested in military (largely operational) and civil (largely exploratory and research) reflect the priority that must be afforded our strategic and scientific requirements.

QUESTION 9

Is there a need to establish and articulate long-term policy goals for the civilian space effort?

ANSWER 9

I believe adequate policy guidance exists.

QUESTION 10

Many have proposed that the United States should commit to development of a Global Resource Information System. Establishing of a national operational civil remote sensing system is a first step.

a. Should the United States commit to a Global Resource Information System?

b. What benefit would be derived from such an undertaking?

ANSWER 10

I believe the United States should commit to such an information system in order to provide unbiased data permitting wiser management of Earth's fragile and limited natural resources. However, to move directly into such a massive undertaking is premature at the present time. It is, for instance, not at all clear that a single organisation should be responsible for acquiring and holding all the information in our constantly growing data bases. A system that ties all the relevant and accurate data bases into an interactive network may prove to be a superior approach. NASA currently has under study an Applications Data Service which, as its name implies, will be used to manage Space Applications Data. During the years required for its full definition and development into a global information system of limited scope, we expect to solve many of the technical and managerial questions that will govern the creation of the full scale Global Resource Information System to which the United States should commit.

QUESTION 11

Should we support distant long-term programs such as the Search for Extra-Terrestrial Intelligence and Space Colonization?

ANSWER 11

Yes, goals of this type are the very long term purposes of space exploration.

QUESTION 12

In March the Congress received a revised NASA Fiscal Year 1981 budget request which reduced the 1981 budget but will result in an increased cost to the taxpayer to accomplish the same programs.

a. What advice do you have on minimizing the impact of such politically motivated decisions?

b. Would NASA have been better off to terminate an ongoing development program?

ANSWER 12

Facing difficult fiscal realities has always been a joint problem shared by the Administration, the Congress, the involved action agency, and the public. Stretching programs to reduce near-term costs at the expense of runout increases has a natural limit--when the combined time and money cost of slippage could be invested in an activity of at least equivalent R&D and social value. Otherwise, there is no question that terminating ongoing work is damaging to the Nation's ability to pursue advanced effort in the future.

QUESTION 13

Are we adequately supporting civil space-laser applications? Should NASA be more involved in this activity?

ANSWER 13

Current emphasis is and should be on the relatively narrow military interests in high energy beam systems. Civil applications, which are more diffuse in that they range from communications to propulsion, can be explored at a slower rate. In response to the Committee's request, we have referred to DOE and DOD the assessment of the possibilities of a unified civilian/military high energy laser effort and the formulation an appropriate institutional structure to plan and execute such a program.

QUESTION 14

We are approaching the fifth anniversary since an American flight crew last traveled in space and are approaching more than four years during which no imaging data will be returned from other planets via United States spacecraft.

a. Should we be concerned? What does this say about our Nation's commitment to maintain a leadership position in space?

ANSWER 14

Imaging data are being returned from the Voyager missions as they proceed through the solar system to Saturn and beyond. However, the thrust of the question deals with a perceived weakening of U.S. will and of U.S. commitment to space exploration. These are difficult parameters to measure accurately. The Administration's willingness to initiate Gamma Ray Observatory and National Oceanic Satellite System, to continue International Solar Polar Mission, Galileo and to hold Shuttle schedules, all in the force of strong budgetary pressures, reflect a commitment to maintain U.S. leadership.

QUESTION 15

Can we really expect a significant expansion of public interest and a reasonable return on our national investment without a challenging space engineering initiative?

a. How can such a program be made appealing?

b. What should the criteria be for identifying the program?

ANSWER 15

We have received, in my opinion, a much greater return on all our space investments to date than from perhaps any other Federal R&D activity. That historic investment has comprised both large and small projects as well as steady support to scientific and engineering research. No single project, by itself, can ever provide the returns that are possible from a balanced, continuing, and broadly supported program of varied interests even at a lower annual investment rate. Within such a program of balanced progress, however, highly challenging space engineering initiatives have a critical place. Criteria for selection should include at least the following:

- Requires contributions from many different disciplines, industries, and individuals.
- Enhances, visibly, both the civil and military purposes of the Nation.
- Will be supported politically and financially for at least a decade.
- Builds permanent national pride, independence, and power.

QUESTION 16

What lessons were learned from the post Apollo era that should now be applied to deal with the post Shuttle era?

ANSWER 16

Perhaps, one lesson is to never count upon a post-development "dividend" as the source of funds for deferred new projects. However, the projects -- Apollo and Shuttle -- are as different in character (one dead ended in nature and one leading to a national transportation system) that it is difficult to draw valid comparisons.

QUESTION 17

We have completed many first generation science missions and are ready to proceed with more intensive exploration.

a. Do the costs rise considerably?

b. What level of annual funding is needed to support a healthy space science program?

c. Can we afford to and should we maintain both an aggressive physics and astronomy program and an aggressive planetary exploration program?

ANSWER 17

Yes, second-generation science costs tend to be higher on a "per mission" basis but far lower on a "per piece of new information" basis than initial exploratory experiments. Since none of the sciences, including the space sciences, progress smoothly or at equal rates, the real challenge is to phase projects in such a way as to stay within an adequate, realistic annual level and then to stick with that equivalent over time, avoiding the disastrous discontinuities of erratic financial support or the erosion of inflation. Such an extended program commitment would permit aggressive progress in all the space sciences.

QUESTION 18

Are we adequately supporting an aggressive technology base program?

ANSWER 18

This is a problem of considerable concern to us since the technology base has traditionally proven to be the source of new ideas and capabilities which both create new opportunities and reduce schedule and cost risks in flight projects.

As part of our planning, we are developing a technology plan and a strategy to restore our technology base program. Our principal goal is to develop a program which will enable imaginative and affordable future space missions.

QUESTION 19

Are there areas for future space programs which are not being funded but which should be funded?

ANSWER 19

In our judgment additional funding on potential new activities would be very valuable for future space programs.

QUESTION 20

The French are developing a remote sensing system with "stereo" capability which should be useful in geological exploration.

a. Is it wise for the United States to abdicate leadership in such an important technology?

ANSWER 20

It would not be wise--and the U.S. has not abdicated its lead in this technology. High-quality Shuttle-acquired stereo imagery will probably be the first--and for a long time the best--space source of specialized geological information on a large scale.

QUESTION 21

With the completion of the Space Shuttle, NASA will be facing civil service manpower reductions at its development centers including Johnson, Marshall, and Kennedy.

a. Does the Administration plan to allow further erosion of the institutional base or will enough new programs be proposed to justify maintaining the institutional base?

ANSWER 21

I believe the capabilities of our centers will be fully utilized during the era of Shuttle operations by the necessary STS support tasks and by new development efforts.

QUESTION 22

The President's space policy states: As resources and manpower requirements for Shuttle development phase down, we will have the flexibility to give greater attention to new space activities, to continue programs at present levels, or to contract them.

a. Which option would you personally recommend for the future direction of our space program?

ANSWER 22

I would recommend completing the full Shuttle program as a first priority before looking for any dividend from "turn-downs". I would further recommend increasing the scope and level of civil space programs in both science and applications.

QUESTION 23

What can we say about the success of the President's guidance directing technology transfer, data sharing, and hardware sharing between the civil and military programs?

ANSWER 23

The same statement made in Answer 6 is applicable to this question.

QUESTION 24

The Soviet Union has logged more than 30,000 man-hours in space while the United States has logged approximately 22,500. The Soviet Union has also developed space station resupply capability.

a. What are NASA's plans with regard to developing a permanent manned presence in space?

ANSWER 24

No detailed program has been submitted by the Administration or supported by the Congress; we believe that permanent presence in space would be a logical step in utilization of the STS capability, and in extension of human activity into space.

QUESTION 25

What is NASA's current position on retaining operational control of the Space Shuttle?

b. Given the choice, would you prefer that NASA retain operational control, or do you see advantages to turning the program over to a private company or quasi-governmental agency? Please specify what the advantages would be. Is NASA actively discussing its future role in the Shuttle program within the government? If NASA retains operational control of the Shuttle, would its charter have to be changed?

ANSWER 25

Until the STS matures further in terms of operations and user community needs, I do not believe that detailed examination of the options is fruitful. We are not actively discussing the options at present. The NASA Act is sufficiently broad to authorize operation of the Shuttle, as has been the case for Expendable Launch Vehicles.

QUESTION 26

What is your personal opinion of the suggestion that the civilian and military space programs be merged?

ANSWER 26

I would strongly disagree with such a suggestion.

QUESTION 27

Is NASA attracting sufficient numbers of new engineers and scientists to fill out its work force? If not, why?

b. What is NASA doing to attract young scientists and engineers?

c. Does the possibility of hiring freezes, pay freezes and/or reductions-in-force cause engineering graduates to look elsewhere for employment? Does NASA offer comparable salaries to private firms?

ANSWER 27

a. In the past two years the agency turnover has been sufficient to permit increased hiring of young scientists and engineers into the work force. Despite some problems associated with entry level salary comparability, the NASA program continues to sell itself as an opportunity for young scientists and engineers interested in Aerospace research and development.

b. Because of the higher turnover experienced in the past few years we have stepped up our recruitment drives on college campuses, used paid advertising for the first time since 1975 and increased our reliance on our cooperative education programs, which is a primary source of young scientific and engineering talent at many of the installations. We have expanded the baccalaureate co-op program and instituted several pilot graduate co-op programs to enable us to meet our recruitment needs downstream.

In order to assure that we can continue to attract high quality graduates, NASA has been working with OPM to raise entry level scientists and engineers salaries so that they are comparable with those offered by industry. Entry level salaries for those who quality at the GS-5 and GS-7 levels are now set at the maximum permitted by law and the agency is using accelerated promotions (within 6 months instead of 12) to achieve comparability. We have also requested that the entry level steps be raised for co-ops at GS-3/4/5 and entry level scientists and engineers at grades 9, 11 and 12.

In addition, we have negotiated with OPM to streamline the application process. Effective October 1, 1980, OPM has delegated to NASA the authority to examine for AST positions. This will enable applicants to deal directly with NASA and should result in faster job offers.

c. These factors do not appear to be influencing the decisions of applicants, however, the potential impacts on the agency's ability to hire are obvious.

d. Our placement officers report that industry starting salaries range from $19-21K. At this time, NASA can offer $14.6K at a GS-5 (few at this level) or $18.1K at the GS-7 maximum. With accelerated promotion to the GS-9 level, we can offer comparable salaries ($21K) within six months.

QUESTION 28

How successful has the new emphasis been on sharing between military and civilian space programs? Has cooperation increased, decreased or remained about the same since the President's directive on this matter?

ANSWER 28

The same statement made in Answer 6 is applicable to this question.

QUESTION 29

How useful have NASA's five-year plans been for charting the course of the agency and planning specific programs?

ANSWER 29

The five-year planning process is an extremely valuable internal discipline and a useful first-order "new start" screening technique.

QUESTION 30

Are our domestic technology transfer programs sufficiently well organized and funded to ensure the greatest return on our investment in space? Are these programs successful? Should they be expanded?

ANSWER 30

I believe our efforts have been well organized, well run, and adequately funded. They have served as models for many other agencies over the years. Of course, we need to continue adequate funding for space and aeronautics R&D in order to make these transfer programs meaningful.

Mr. FUQUA. Thank you, Dr. Frosch.

Now, as agreed to earlier, we will proceed with the testimony of Dr. Hans Mark, who is the Secretary of the Department of Air Force.

[The biographical sketch of Dr. Mark follows:]

DR. HANS M. MARK

Dr. Hans M. Mark became secretary of the Air Force in July 1979. Prior to his appointment, Dr. Mark was under secretary of the Air Force.

Dr. Mark was born on June 17, 1929, in Mannheim, Germany. He came to the United States in 1940 and became a U.S. citizen in 1945. He attended primary and secondary schools in New York City, earned a bachelor of arts in physics at the University of California, Berkeley, in 1951 and his doctor of physics in 1954 from the Massachusetts Institute of Technology.

Active in teaching since 1952, Dr. Mark taught courses in physics and engineering at Boston University, the Massachusetts Institute of Technology, the University of California at Berkeley and Davis and Stanford University. Concurrently, he was active in research and held a number of administrative appointments. Following completion of his graduate studies, Dr. Mark remained at the Massachusetts Institute of Technology as a research associate and acting head of the Neutron Physics Group, Laboratory for Nuclear Science, until 1955. He then returned to the University of California as a research physicist at the Berkeley campus, then at the university's Lawrence Radiation Laboratory in Livermore, where he served until 1958.

After two years as an assistant professor of physics at the Massachusetts Institute of Technology, Dr. Mark returned to the Lawrence Radiation Laboratory in Livermore to continue physics research and to head the Laboratory's Experimental Physics Division (1960–1964). During that period he was also first an associate professor (1961–1966) and then professor of nuclear engineering (1966–1969) at the University of California's Berkeley campus. He served as chairman of the Department of Nuclear Engineering and administrator of the Berkeley Research Reactor from 1964 to 1969.

In 1969 Dr. Mark accepted the position of director of the Ames Research Center of the National Aeronautics and Space Administration. As director he managed the center's research and applications efforts in aeronautics, space science, life science and space technology. He also continued his association with the academic community, first as a lecturer in applied science at the University of California, Davis campus, from 1969 to 1973 and since 1973 as a consulting professor of engineering at Stanford University.

Dr. Mark has also been a consultant to government, industry and business. He served as a consultant for, among others, the Institute for Defense Analyses (1958–1961); the National Science Foundation (1966–1969); the U.S. Air Force Scientific Advisory Board (1969–1976); the vice president of the United States (1974–1976); The President's Advisory Group on Science and Technology (1975–1976) and the Defense Science Board (since 1975).

Dr. Mark has written extensively; his articles have appeared in a number of professional and technical journals. He also co-authored a volume on "Experiments in Modern Physics," served as co-editor of "The Properties of Matter Under Unusual Conditions," and was a co-author of "Power and Security."

His major scientific accomplishments include contributions to the precise determination of the wave lengths of nuclear gamma rays, to the development of X-ray astronomy, to various fields of nuclear instrumentation and to the development of more accurate atomic wave functions.

Dr. Mark is a member of Tau Beta Pi, Sigma Xi, Phi Beta Kappa and the National Academy of Engineering. He is a fellow of the American Physical Society and the American Institute of Aeronautics and Astronautics. He also belongs to a number of other professional associations including the American Nuclear Society, the American Geophysical Union, the American Association of University Professors and the Society for Engineering Science, of which he was a director from 1972 to 1976. Dr. Mark holds an honorary doctorate of science degree awarded in 1978 by Florida Institute of Technology.

Dr. Mark is married to the former Marion G. Thorpe. They have two children, Jane and Rufus.

STATEMENT OF SECRETARY HANS MARK, DEPARTMENT OF AIR FORCE

Dr. Mark. While I appear here today as a representative of the Department of Defense, you are aware that I have spent almost 9 years working for NASA and many years before that in developing space payloads. I am well acquainted with the civilian aspects of our space program, as well as the military ones.

Even in my present position, I maintain a very close relationship with the people at NASA. I am in almost daily contact with Bob Frosch and his colleagues. I serve on the Aeronautics and Astronautics Coordinating Board, which is our joint body to monitor the overall program. And finally, the Air Force is the executive agent for managing the national security's community involvement in the Space Shuttle program. I am very much involved in that.

I have been involved with the issues that the committee has been considering for a great many years. It is for this reason that I am very pleased to be here.

Our country's space policy is governed by the National Aeronautics and Space Act of 1958. The major provision of that act established a civilian agency to conduct the aeronautical and space activities of the U.S. Government. This agency, the National Aeronautics and Space Administration, is responsible for a number of specific functions intended to preserve the leadership of the United States in aeronautical and space technology. That is the fundamental point.

These functions are quite broad. They have, in large measure, permitted the achievement of the principal objective of the Space Act which, as I have already said, is the maintenance of U.S. leadership in this important field.

During the first decade of American activities in space—that is, from 1960 to 1970—our objective was to establish and demonstrate our leadership by placing men on the Moon and returning them safely to Earth. This enterprise was triumphantly successful, and I personally believe that 100 years from now when people talk about the year 1969, what they will remember is the fact that Neil Armstrong stepped on the Moon for the first time.

I would like to say a word about aeronautics, as well, because the charge is to maintain leadership in space and aeronautics. In aeronautics also, we have maintained technological leadership in the world. Eighty-five percent of all commercial aircraft of the non-Communist world are of American manufacture. Products connected with aeronautics are the second biggest export item that this country has, after agricultural products. We exported almost $18 billion worth of aeronautical products last year. The F-15 and the F-16 are the finest military aircraft of their class in the world.

All of these achievements, everything I have just said, are the result of technical developments that could not have been possible without the research, development, and testing performed in Government-owned aeronautical facilities operated by NASA. That is a very important point.

After the landing on the Moon in 1969, a new objective was decided upon. At that time, it was apparent to many people—and I was involved in those discussions in 1968 and 1969—it was apparent that a truly large-scale operation in space could not be performed with expendable launch vehicles. You cannot throw away 90 percent of what you put up there every time. Therefore, it was decided to develop a reusable launch vehicle.

The second decade of our activities in space have been dominated by the effort to develop that vehicle. There have been technical problems and delays, but I am confident that the initial phase of the Shuttle program will shortly be brought to a successful conclusion with the first manned orbital flight.

The Shuttle will be used by all who are going to space for commercial purposes to do research and development and to conduct space missions which enhance the national security. It will be a truly national launch system, and it marks the first major departure in launch vehicle technology in two decades of activities in space.

It is most important, in my judgment, to make every effort to push this program through to a successful conclusion. Our future leadership in space depends upon it.

To summarize, our policies in space activities have been simple—and far reaching. In the 1960's, we unequivocally established American leadership in space by going to the Moon. Simultaneously, we preserved our strong position in aeronautics.

In the 1970's, we have concentrated on developing an entirely new launch vehicle designed, again, to preserve and enhance that leadership.

I would like now, Mr. Chairman, to turn to a brief discussion of activities in space related to the national security. The 1958 Space Act specifically designated the Department of Defense to be responsible for and to direct—and I quote—

> those activities peculiar to or primarily associated with the development of weapons systems, military operations, or the defense of the United States (including the research and development necessary to make effective provisions for the defense of the United States).

Our charter of the Department of Defense is very broad and comprehensive. Today, 22 years after the enactment of the 1958 Space Act, our activities in space are crucial to the security of the United States.

There are two missions above all others that stand out as being of vital importance to the national security. One has to do with providing timely warning of possible attacks by strategic missiles that the Soviet Union or other nations possessing them might launch. Our strategic deterrent forces depend heavily on warning, which will allow our strategic bombers on alert to get off in time, as well as for a number of other activities related to the readiness of our strategic forces.

Satellites provide these warning or signals: They give the alert which allows the bombers adequate time to taxi to the runways and takeoff.

The second function is surveillance. Surveillance is equally important because we depend heavily upon space systems to know what our potential adversaries around the world are doing. In the last few years, we have unfortunately lost routine access to large regions of the world, such as Afghanistan, Ethiopia, Iran, and Angola. Our space systems have accordingly become much more important.

Because this trend is likely to last for some time, in my view, these surveillance systems will become even more important in the future. Those who believe that the control of strategic arms is an important element of our defense policy know about the importance of our space surveillance systems in achieving that arms control. The treaties that we have concluded with the Soviet Union in the past would not have been possible without national means of verification. I am firmly convinced that future treaties in this very important area will require even more sophisticated surveillance systems in space.

For these reasons, it is more important than ever, in my mind, to maintain the technological lead that we have talked about.

Mr. Wydler asked a few minutes ago what major new initiatives the Administration has made in space, and in Dr. Press's statement you notice that we have increased investment at the rate of 15 percent per year in national security space systems. We have made major new initiatives which I unfortunately cannot talk about in an open hearing. We have been exceedingly active in developing new technology in that area and putting into operation new space systems based on it.

The two separate space programs mandated by the 1958 Space Act, one related to all civilian matters and technology development and the other to the national security, have served the Nation well. In May 1978, President Carter issued a directive that reaffirms the importance of this congressionally mandated division of responsibility. It is my firm opinion that the Space Act and the division of responsibility incorporated in it have been extremely important to the healthy development of our space activities.

We have been able to conduct a completely open and unclassified civilian space program which, in my judgment, has been of great benefit to the Nation. At the same time, we have been able to conduct on a parallel track a classified program that is vitally important to the security of the United States.

The Presidential directive also calls for even closer cooperation between civil and military programs, to share wherever possible the technology developed by each of these sectors. This technology sharing has been going on ever since I can remember, and I have been in the business for well over 20 years. Let me just mention a few examples, just to give you a flavor:

The Department of Defense has helped NASA in a substantial program for development of new computers that are put on spacecraft. It includes computer circuitry design and onboard processors. We have worked with NASA on image processing systems from aircraft for use on satellites. We have contributed to NASA's development of large space structures, and the Langley Research Center has the leadership in that area. We have worked with NASA on propulsion systems. We are now using the NASA developed multimission spacecraft for national security missions. That is a space vehicle designed for common application.

All of these examples represent significant savings in the Nation's space program.

I do also want to mention what I think is a most important cooperative effort. That is the employment—by the Department of Defense directly and by the contractors of the Department of Defense—of the

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wind tunnel and flight simulator facilities that are operated by NASA. We could not have today's strength in military aeronautics without continuing and intensive use of these facilities and of the people that run them. I want to stress this because the quality of the NASA engineering talent that works on military aeronautics is superb. It has been superb for many decades, in fact ever since 1917, when NASA's predecessor, the National Advisory Committee on Aeronautics (NACA), was established.

These are a few examples of what has been done. There is no doubt in my mind whatsoever that the cooperation of the kind I have talked about will continue. It is obviously to the advantage both to the civil and national security of the country.

Let me close by saying again that I very much appreciate the opportunity that you have given me here to testify on this very important matter. I would like to take the opportunity to thank you, Mr. Chairman, and the other members of the committee, who have supported our Nation's space programs throughout the years. I am certain that your vision and your far-sighted actions will be of great benefit to this country in the future.

Thank you very much.

[The prepared statement plus answers to questions asked of Secretary Mark follows:]

DEPARTMENT OF THE AIR FORCE

PRESENTATION TO THE COMMITTEE ON SCIENCE AND TECHNOLOGY

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

HOUSE OF REPRESENTATIVES

JULY 24, 1980

SUBJECT: REVIEW BASIC TENETS OF ADMINISTRATION'S CIVILIAN SPACE POLICY AND EXAMINE CIVILIAN SPACE POLICY RELATED ISSUES AND CONCERNS

STATEMENT OF: DR. HANS MARK
SECRETARY OF THE AIR FORCE

NOT FOR PUBLICATION UNTIL
RELEASED BY THE COMMITTEE
ON SCIENCE AND TECHNOLOGY,
HOUSE OF REPRESENTATIVES

Mr. Chairman and members of the Committee: I am very pleased to have this opportunity to appear before you to discuss our national space policy. While I appear here today as a representative of the Department of Defense, you are probably aware that I have spent eight and a half years working for NASA. Consequently, I am also well acquainted with the civilian aspects of our space program. Even in my present position, moreover, I remain in close--almost daily--contact with my NASA colleagues, both because I serve on the NASA-DOD Aeronautics and Astronautics Coordinating Board (AACB) and because the Air Force is Executive Agent for management of the Defense Department's participation in the space transportation system--the Space Shuttle. In short, I have been involved for many years with the issues which I understand you will be considering in this hearing.

This nation's space policy is governed by the National Aeronautics and Space Act of 1958. The major provision of that Act established a civilian agency to conduct the aeronautical and space activities of the United States Government. This agency, the National Aeronautics and Space Administration (NASA), is responsible for a number of specific functions intended to preserve the leadership of the United States in aeronautical and space technology. These powers are quite broad, and they have, in large measure, permitted the achievement of the principal objective of the Space Act which, as I have already said, is the maintenance of United States leadership in this important field.

During the first decade of American activities in space, our objective was to establish U.S. leadership in space activities by placing men on the Moon and returning them safely to Earth. This enterprise was triumphantly successful and a century from now, the year 1969 will be remembered because it witnessed Neil Armstrong's first step on the moon. In aeronautics as well, we have maintained our technological leadership. Eighty-five percent of all commercial aircraft in the non-Communist world are of American manufacture. And the F-15 and the F-16 are the finest military aircraft of their class in the world. All of these achievements are the result of technical developments that could not have been possible without the research and testing performed in government-owned aeronautical facilities that are operated by NASA.

After the landing on the moon in 1969, a new objective was decided upon. At the time, it was apparent to many people that truly large-scale operations in space could not be performed with expendable launch vehicles. Therefore, it was decided to develop a reusable launch vehicle, the so-called Space Shuttle. The second decade of our activities in space has been dominated by the effort to develop the Space Shuttle vehicle. There have been technical problems and delays, but I am confident that the initial phase of the Shuttle program will shortly be brought to a successful conclusion with the first manned orbital flight of the vehicle early next year. The Shuttle will be used by all who will go into space--for commercial purposes, to do research and development, as well as to conduct space missions which enhance the national security. It will be a truly "national" launch system and it marks the first major departure in launch vehicle technology in the two decades of activities in space. It is very important, in my judgment, to make every effort to push this program through to a successful conclusion. Our future leadership in space depends on it.

To summarize, then, our policies in space activities have been simple--and far-reaching. In the 1960's we unequivocally established American leadership in space by going to the Moon. In the 1970's we have concentrated on developing an entirely new launch vehicle designed to preserve and enhance that leadership.

I would now like to turn to a brief discussion of activities in space related to the national security. The 1958 Space Act specifically designated the Department of Defense to be responsible for, and to direct, "those activities peculiar to or primarily associated with the development of weapons systems, military operations, or the defense of the United States (including the research and development necessary to make effective provisions for the defense of the United States)."

The charter of the Department of Defense is very broad and comprehensive and today, 22 years after the enactment of the 1958 Space Act, our activities in space are crucial to the security of the United States. There are two missions above all others that stand out as being of vital importance to the national security. One has to do with providing timely warning of attacks by strategic missiles and the other is to conduct surveillance on a continuing basis. Our strategic deterrent forces depend heavily on warning which will allow our strategic bombers on alert to get off in time, as well as for a number of other activities related to the readiness of our strategic forces. The surveillance function is equally important, because we depend heavily on space systems to know what our adversaries around the world are doing. In the last few years, we have lost routine access to large regions of the world--Afghanistan, Ethiopia, Iran, and Angola, to name just a few. Our space systems have accordingly become more important.

Because this trend is likely to last for some time, they will become even more important in the future. Those who believe that the control of strategic arms is an important element of our defense policy know about the importance of our space photo reconnaissance systems in achieving that control. The treaties that we have concluded with the Soviet Union in the past would not have been possible without "national means of verification." I am firmly convinced that future treaties in this area will require even more sophisticated surveillance systems in space. For these reasons, it is more important than ever that we maintain the lead in critically important space technologies.

The two separate space programs that are mandated by the 1958 Space Act--one related to all civilian matters and technology development, and the other related to the national security--have served the nation well. In May of 1978, President Carter issued a directive that reaffirms the importance of this Congressionally-mandated division of responsibility (PD-37). It is my firm opinion that the Space Act and the division of responsibility incorporated in it have been extremely important to a healthy development of our space activities. We have been able to conduct a completely open and unclassified civilian space program which has been of great benefit to the nation. At the same time, we have been able to conduct on a parallel track classified space programs that are vitally important to the national security.

The Presidential Directive also calls for even closer cooperation between civil and military programs--to share, wherever possible, the technology developed by each of the sectors. This technology sharing has been going on for some time and I am pleased to report here some examples:

The Department of Defense has helped NASA in a substantial program for the development of spaceborne computer processors, to include computer circuitry design and the development of on-board computer processors that reduce spacecraft weight and improve system performance.

The Department of Defense has helped NASA apply techniques from aircraft systems to process images from satellites. This activity includes enhancement of images, processing of data and the interpretation of data. The joint effort to upgrade the digital image processing at the Goddard Space Flight Center for the LANDSAT program is part of this effort.

The Department of Defense has contributed to NASA's program to demonstrate the use and feasibility of large space structures. General construction techniques and calibration of antennas for communications are specific items in which we have been able to lend a hand.

The engine for the Air Force's improved transtage will be used on NASA's Delta launch vehicle, which is itself an outgrowth of the old Thor program operated by the Department of Defense.

The NASA multimission spacecraft will be used by the Department of Defense on selected missions. Conversely, NASA plans to use on this spacecraft command and data handling systems incorporated from a Defense Department design.

All of these examples represent significant cost savings to the nation, in terms of both manpower and dollars. The Department of Defense and NASA have also been able to coordinate our technology activities in ways which have been similarly advantageous. For instance, the Department of Defense performed a LANDSAT follow-on review and provided both information and facilities to NASA for the development of their request for contractor proposals. The major scientific effort with the Space Telescope has also incorporated many Department of Defense hardware items.

These are only a few examples of what has been done. There is no doubt whatsoever, in my mind, that cooperation of this kind will continue not only because it is mandated, but because it is obviously to the advantage of both the civil and the national security communities.

I very much appreciate the opportunity that you have given me here to testify on this very important matter. I would like to take this chance to thank you, Mr. Chairman, and the other members of Congress who have supported our nation's space programs, both civilian and military, throughout the years. I am certain that your vision and your far-seeing actions will be of great benefit to the United States in the future. I would be very happy to answer any questions that you may have. Thank you very much.

Question 1. New programs and goals are being dictated by year-to-year budget pressures and funding problems with the Space Shuttle.

(a) What can be done to overcome the resultant erosion of our technology base and capabilities?

(b) Is NASA proposing enough new programs to justify maintaining a healthy institutional base?

Answer. 1(a). The technology base program should be adequately funded independent of budget pressures due to other programs. This should be done as a matter of national policy.

1(b). I am not sufficiently familiar with NASA's fiscal year 1982 proposals to answer this question.

Question 2.—One tenet of the Administration's space policy states: it is neither feasible nor necessary at this time to commit the United States to a high-challenge space engineering initiative comparable to Apollo.

(a) Do you agree with this statement?

(b) What do you consider to be appropriate long-term goals for NASA to undertake after completion of the Space Shuttle?

Answer. 2(a). I agree with the statement if it is interpreted to mean a project other than the Space Shuttle. We must push the Space Shuttle through to a successful conclusion. I believe that the choice of language in this statement may have been unfortunate since a negative statement of this kind should never be part of a proclamation of goals.

2(b). The next major commitment after the Space Shuttle is completed should be the development of a permanently orbiting, manned space station.

Question 3. Should NASA's charter be broadened to include a greater role in dealing with other national needs such as energy?

Answer. Definitely not. NASA is not properly equipped to deal with the technical and institutional problems in any other field except aeronautics and space.

Question 4. Should NASA perform research and development only, while avoiding operational responsibilities?

Answer. Under the 1958 Space Act, NASA can operate systems if they are experimental in nature. It seems to me that this charter is broad enough for NASA to conduct a wide variety of operational programs provided that a proper interpretation of the word "experimental" is made. For example, I would argue that NASA could set up an experimental operational LANDSAT program under the current law.

Question 5. Is NASA appropriately staffed and does it have the appropriate number of field centers for its projected role?

Answer. NASA is properly staffed and has the right number of field centers. In answering this question in the affirmative, I do not mean to imply that there can be no improvement. I am simply saying that the numbers today are "approximately" correct.

Question 6. What concerns, if any, are raised by the President's directive providing new guidance directing technology transfer, data sharing, and hardware sharing between the civil and military programs?

Answer. Technology transfer between the military and the civilian space programs has always been very effective. The technology transfer process occurs primarily at the factories of the contractors and it is effective because the same contractors serve both the civil and the military space programs.

Question 7. Does the National Aeronautics and Space Act of 1958 provide an adequate charter for civil space activities? Is there a need to reaffirm the Nation's leadership in exploring and developing the space environment for the benefit of mankind?

Answer. The National Aeronautics and Space Act of 1958 provides an excellent charter for civil space activities. The best way to affirm leadership is not by making statements but by doing things. NASA has reaped benefits from the public information programs surrounding the planetary exploration program in recent years. NASA should do the same thing with the Astronomy program as well. Also, we should develop a much more imaginative public information program highlighting what we are doing in the communications satellite business. I am not sure that people really understand how much we depend on space systems for ordinary communications.

Question 8. While NASA's eroded budget is barely holding its own against inflation, the DOD's space budget is accelerating.

(a). Is the Nation pursuing a proper balance between the civilian and military aspects of the nation's space program?

Answer. The national security related space programs have had substantial increases in their budgets for two reasons: One is the recognition that both national defense and strategic arms limitation agreements requires extensive space based surveillance and verification systems. The second is that the requirement to make the transition of various spacecraft systems to the Shuttle has added some conversion costs. I do not know what the word "balance" means in connection with this question. The civilian and military space programs need to be examined separately and the funding needs to be adjusted according to the requirements that are developed for each program. The funding rise in the military space program in the past few years is due, in my opinion, to the compelling nature of the requirements in this program.

Question 9. Is there a need to establish and articulate long-term policy goals for the civilian space effort?

Answer. There is always a need to develop and refine long-term policy goals. The goal we have now is quite definite, which is to make the Shuttle operational. As I have already said in reply to question 2b, we should, after the Shuttle is complete, commit to the development and construction of a manned orbiting space station. This program goal would be consistent with the U.S. policy goal of maintaining leadership in space.

Question 10. Many have proposed that the United States should commit to development of a Global Resource Information System. Establishment of a national operational civil remote sensing system is a first step.

(a). Should the United States commit to a Global Resource Information System?

(b). What benefit would be derived from such an undertaking?

Answer. 1(a), and 10(b). I cannot answer either one of these questions since I do not know enough about the proposed "Global Resource Information System" to make an authoritative judgment.

Question 11. Should we support distant long-term programs such as the Search for Extra-Terrestrial Intelligence and Space Colonization?

Answer. Yes, we should support "distant long-term" programs such as Space Colonization and the Search for Extra-Terrestial Life if ideas such as these can be made to capture the imagination of the public. This is an important criterion because not every "distant long-range" idea can do that. As you know, I was partly responsible for starting both of these concepts while I was serving as Director of NASA's Ames Research Center. It is important to recognize, however, that these are both very long-term programs and that, therefore, the funding for these programs should be limited to $1–2 million annually for each program for the foreseeable future.

Question 12. In March the Congress received a revised NASA fiscal year 1981 budget request which reduced the 1981 budget but will result in an increased cost to the taxpayers to accomplish the same programs.

(a). What advice do you have on minimizing the impact of such politically motivated decisions?

(b). Would NASA have been better off to terminate an on-going development program?

Answer. 12(a). and 12(b). I cannot honestly comment on these points since I am not familiar with the contents of NASA's revised fiscal year 1981 budget request.

Question 13. Are we adequately supporting civil space-laser applications? Should NASA be more involved in this activity?

Answer. Yes. I believe that space-laser applications programs are adequately funded.

Question 14. We are approaching the fifth anniversary since an American flight crew last traveled in space and are approaching more than four years during which no imaging data will be returned from other planets via United States spacecraft.

(a). Should we be concerned? What does this say about our nation's commitment to maintain a leadership position in space?

Answer. 14(a). Manned space flight is definitely a measure of leadership in space activity and we must get on with it as rapidly as possible. It is not as clear to me that planetary fly-bys are a similar measure of leadership. While such events do attract considerable public attention, there may be other things we can do that are similarly attractive. Specifically, I believe that the construction of an orbital space station would attract an equal amount or even more attention than another planetary fly-by.

Question 15. Can we really expect a significant expansion of public interest and a reasonable return on our national investment without a challenging space engineering initiative:

(a). How can such a program be made appealing?

(b). What should the criteria be for identifying the program?

Answer. 15(a). and 15(b). We do have a challenging engineering initiative—the Space Shuttle—which must be brought to a successful conclusion. The next logical step is the manned space station. The most important reason for embarking on this effort is that the station is the only way to establish the presence of man in space in a permanent way. In the long term, that is the only way this new frontier can be properly opened and exploited.

Question 16. The President's space policy states: As the resources and manpower requirements for Shuttle development phase down, we will have the flexibility to give greater attention to new space activities, to continue programs at present levels, or to contract them.

Answer. This is not a question, but a statement. If I am permitted to choose between the alternatives presented, I would spend more money on space activities than we are spending today.

Question 17. Would you comment on the appropriateness of the Space Shuttle as a national space transportation system?

Answer. The Space Shuttle is appropriate as a National Space Transportation System.

Question 18. What can we say about the success of the President's guidance directing technology transfer, data sharing and hardware sharing between the civil and military programs?

Answer. Generally speaking, the President's policies on technology transfer and technology sharing have been successful. I provided some specific examples of these during my formal testimony before the Subcommittee.

Question 19. Dr. Mark, what areas do you consider most fruitful for joining NASA/DOD efforts?

(b). To what extent can clarification of National Space Policy contribute to fuller NASA/DOD joint space efforts?

Answer 19(b). The most fruitful area of collaboration will be the conduct of shared flights once the Space Shuttle program becomes operational.

Question 20. If the nation embarks on developing the capability to build large space platforms or structures should NASA or the Department of Defense take the lead role?

Answer. Whichever agency has the major requirement for space platforms or structures should also take the lead in their development.

Question 21. Are you satisfied that the Space Shuttle System will satisfy DOD launch requirements?

Answer. Yes.

Question 22. Can you generalize with regard to what areas lend themselves to shared military/civilian systems?

Answer. I have already commented on the question of shared technology in my formal testimony.

Question 23. What is your personal opinion of the idea of merging the military and civilian space programs? What advantages and disadvantages do you see to such an action?

Answer. Merging the civil and military space programs would have no advantages. The major disadvantage would be that we would no longer be able to operate a completely open and unclassified civil space program.

Question 24. If the civilian and military programs were merged, what international repercussions, if any, would you expect?

Answer. I don't know what the international repercussions would be. In any event, I don't believe that possible international repercussions should govern the organization of our space program.

Question 25. What would happen to DOD shuttle missions if management of the shuttle were passed off to a private company once the system is operational? Would DOD insist on complete operational control over military shuttle missions?

Answer: I believe that a private company could successfully manage the operational aspects of the Shuttle. The Department of Defense would insist on the ability to perform the mission control functions for certain very sensitive missions. The ability to perform mission control for "dedicated" missions of this kind is a provision of the recently executed Memorandum of Understanding on Shuttle Operations between NASA and the Department of Defense.

Question 26. *How successful has the new emphasis on sharing between military and civilian space programs been? From your personal knowledge, has cooperation between NASA and DOD increased, decreased, or remained about the same since the President's directive on this matter?*

Answer. I have already commented on this point several times.

Mr. Brown. (presiding). I am going to make an effort to ask a few questions, despite the fact that I have just come from the dentist, until the chairman gets back, and he can continue more effectively.

Mr. Secretary, I would like to address this question to both you and Dr. Press. One of the matters of high policy that is continually arising in the space program is the proper division of space activity between the civilian and the military aspects.

I think reasonable people can differ as to where the technologly ought to be, but it has been of some concern to us—and there seems to be a declining commitment of resources to the civilian program, in comparison with the military, while the military continues to go up.

Now, of course, we understand the importance of national security and the reasons for military operations in space, but it is a little difficult for us in the committee to evaluate those decisions. We are aware from generally available information that there is a thrust toward the development of not only surveillance, intelligence capabilities, but anti-satellite capabilities and the protection of these.

We occasionally see references to the fact that there are at least some in the military that feel that the civilian space program is sort of a needless luxury and that the military could be doing all of the activities in space. I would like each of you to comment, if you could, as to how you see the future developing.

Is this decline of civilian space activities to continue in comparison with the military? Is there any possibility that the programs will be integrated under military supervision?

Also, if you could offer us some gratuitous advice, how do we in the Congress, with our jurisdictional departmentalization, look at this in a comprehensive way to assure that the best efforts of the Nation are protected with regard to this policy?

Dr. Press. Let me start on this, Congressman Brown.

Mr. Brown. Yes.

Mr. Press. The civil and the military space budgets are about equal at the present time. It is correct that the rate of growth in the national security area is somewhat larger. That is because they started with much less; national defense needs now dictated a more rapid buildup.

The priorities are set by the needs in the different sectors. We are not building in the defense area at the expense of the civil sector. It has never been viewed that way. The defense needs are analyzed in their own right. Decisions are made according to the best case that they can make for defense requirements.

In the civil area, we similarly evaluate proposals from NASA in terms of the importance of that application or the science and technology that they want to develop.

The funding decision is made in the context of the overall budget, rather than civil versus the defense budget. No one in this administration wants to build our defense space capability at the expense of the civil space capability. We want an aggressive civil space program. We look forward to receiving proposals from NASA and from the other agencies in the civil area. I do the best I can to support those programs within the administration. I would like to say that cooperation does not mean to have one sector, like the military, take over and the other, like the civil, but to share the technology, and effect cost savings. In this way we will have the best of both elements.

Now, always we have in mind the great importance of the civil space program and the need to protect it as an important national endeavor. In the area of defense, it is extremely important that we use high technology systems for our national security. This Nation is very good in that area. There is no reason why we should not benefit from the great technological strength in the defense area in the civil space system.

Mr. **Brown.** Go ahead, Mr. Secretary.

Secretary **Mark.** Mr. Brown, I might add only one thing to what Dr. Press has said.

Mr. **Brown.** Yes.

Secretary **Mark.** That is to give the reason why I believe the growth in the national security sector has been larger in the past 4 years than in the civil sector. I think that in the development of the SALT II Treaty, it was recognized by all concerned that the verification process required an investment in space systems devoted to the national security. We consequently made some commitments to the systems. I think that was one driver.

Also, as I mentioned in my prepared statement, there are unfortunately fairly large areas of the world to which we no longer have normal access. There is a feeling that perhaps this is a continuing trend. Even if it is not a continuing, quantitative trend, we may gain access in one place only to lose it elsewhere.

Therefore, an investment in the kinds of systems that the national security community deals with is important. I think this is an illustration of what Dr. Press said on how our investment decisions are made. They are made based on requirements.

Mr. **Brown.** That is a very reasonable position, Mr. Secretary. It is certainly one that people can understand. The need for additional intelligence information becomes saturated fairly soon. I thought at times in the past you were already saturated with raw data, and you were suffering more in the capability of digesting it more than the ability to accumulate it.

So I can see that particular part of the program peaking out at some reasonable area of expenditure or effort, but the part I do not see as peaking out is that which is related more to, shall we say, maintaining a degree of parity with our potential enemies in terms of protecting these systems or negating their systems.

That is the sort of thing that is very hard to peak out. When both sides think that they can do it, that can lead to an overwhelming amount of effort devoted to military systems. Are you in a position at this time to tell the committee, even in a rough way, what percentage of your program is devoted to the gathering of information and what percentage is devoted to protecting the capability of gathering or negating the enemy's capability of gathering intelligence data?

Secretary **Mark.** I cannot put those numbers on the table, sir, because they are classified. I would be happy to do it in a closed session.

Mr. BROWN. Thank you.

Secretary MARK. What I can say is this. The need for survivability of our national security space systems was recognized very early in the administration as a major factor. The President, as you know, issued two documents that govern the administration's activities in space. In both, the survivability of space systems was put at a very high level of priority. If you wish, I can go into some of the details, not here, but perhaps after the meeting.

The second thing the administration has done is to seek to negotiate a treaty which would limit antisatellite activities. This was initiated by the President, in part to supplement the noninterference part of the SALT 1 treaty with national means.

The policy the administration has followed in this area thus has two elements. One is to make substantial investments in increasing the survivability of our spacecraft; the second is to try to negotiate a verifiable treaty. So we are very much aware of the antisatellite problem.

Mr. BROWN. If I may just conclude with one point, if we are unsuccessful in following the latter course, and, therefore, there are no reasonable ways to protect that phase of the program, and if we complete the high budget phase of the Shuttle and the civilian program will tend to be reduced as a result of that, then what can we expect to see in terms of the relative size of the military versus the space program under these conditions, say, 3 to 5 years from now? Is there going to be a growing disparity?

Mr. FUQUA. Could I interrupt?

Dr. Press has to leave in a few minutes.

Mr. BROWN. I understand.

Mr. FUQUA. There may be some questions directed to him. Then we could come back to Secretary Mark, if that is agreeable.

Mr. BROWN. Yes. Dr. Mark has been carrying most of the ball. I want to include Dr. Press in the dialog.

Dr. PRESS. In formulating the total space budget, military and civil, we do not trade off one against the other. Each is proposed and defended upon the basis of its own merits. I am hopeful that the civil space program which we will see in the next few years will include proposals that are so good and important we cannot afford to turn them down as a nation. For example, there is the Venus orbiting imaging radar, and new space applications which will be proposed by us.

In the defense area, because of arms control reasons or new possibilities for protecting the security of the Nation, defense will make proposals that will be considered on their own merit. I think to portray one sector as competing against the other or being traded off against the other is not an accurate description of the way that we do business.

Dr. FROSCH. Perhaps I might add a comment. When I make a list of the problems I am concerned about, as to this point of view, the question of whether the defense program is going to take over the civil program or the question, indeed, of whether the defense program budget is larger or smaller than the NASA budget does not even come near to making the list. Those are simply not concerns that I have in the way that the system operates. There has been, to my knowledge, since I have been onboard which is 3 or so years, no policy level discussion even of the subject of that kind of a revision of the arrangement. Heaven knows what discussion there is outside of the level that we really have to talk about realistically. I do not think such a thing has been under consideration at all. When I argue my budget problems, as I do, it has simply never been a consideration or a question as to what was happening in the defense budget on the level of either NASA or the space budget.

That may happen on the level of the total national budget, but that is a different question.

Mr. Brown. I will defer at this time.

Mr. Fuqua. Thank you.

Now, according to the President's space policy directives you indicated this is not the time to commit ourselves to a high challenge space engineering initiative. What is the right time? Is this based on economic factors? Is this based on public support in space?

What are the factors that go into those decisions?

Dr. Press. Let me enlarge upon that.

Mr. Fuqua. Go ahead.

Dr. Press. When I speak of a high challenge, single engineering feat, I am talking about a $25 to $100 billion effort, something on the order of Apollo or an effort that would involve, perhaps, placing men on another planet or something like that. I think that the time for that kind of a proposal, personally speaking, would be sometime early in the next century. This is not to say that NASA will not embark on important high technology missions. I think the space transportation system is not a system that will be finished next year. It will be an evolving system whose capabilities and whose technological capability will improve over the years.

The Shuttle can be augmented by additional equipment and thrust which will enable it to do much more over the next decade or 15 years than it can do in the earliest years of flight. That in itself will be a very important national engineering effort.

NASA will be involved in high technology developments. When I speak of a single high technology feat, it is a major next step, for example, colonization of space or to go to another planet. I think the evolution of a Shuttle system and the kinds of work it can do in space and the manufacture and construction in space will be a first and necessary step toward the later stages. I am sure we will get into, in the next century, extremely expensive, high technology and perhaps international programs for space colonization or planetary colonization.

Mr. Winn. We have a stated policy of maintaining world leadership in space. Now, Frank, how do you determine or quantify leadership? How would you characterize our leadership status today?

Dr. Press. I think we have a tendency to decry our efforts and to underestimate our contributions. I think it is recognized throughout the world. We dominate space technology and space applications. In space sciences the major discovery of planets and major discoveries in astrophysical sciences have been American. The major developments in communications satellites and remote sensing have been American contributions. The space transportation system, as I mentioned earlier, no group of nations will touch us in that capability for the rest of this century. I think that illustrates dominance of space technology today. That is what we enjoy. That is what I think we will enjoy in the future.

Mr. Winn. We had two witnesses yesterday that gave very interesting testimony. They both thought in various degrees that we were losing our leadership in space, not the technology, but I think because they did not feel that we had any new challenges or new programs that you have been questioned about already. Now that we see some new incentives from our friends in Europe, then what role do you think the international cooperative programs will play in our future space activities?

Dr. Press. I think that we have to maintain an aggressive space policy, a national space program. We want to do that for many reasons. The technology is important in many different sectors. It demonstrates world leadership. It stimulates our industrial sectors in many different ways.

You heard about the aircraft sector. Nevertheless, technology is pushing us into the kinds of global projects, multibillion-dollar projects whose benefits accrue to the entire world. These are risky projects. They take a long time. They are socially useful to people everywhere.

I think that because of these reasons that we will welcome international cooperation in space projects. It may well be that the kinds of things we were talking about before, such as space colonization and planetary exploration, will be international projects.

Our present programs of international cooperation in scientific programs in space are very important to us. They help share the responsibility and contribute intellectual resources which make the project stronger. So I think increasingly, Mr. Chairman, we will see this kind of international cooperation.

Mr. Winn. In many cases, the very nations that we would most likely cooperate with in space ventures are probably the ones we will be competing with in the world market, just like we are in the aircraft industry. There are more and more countries that are building aircraft similar to ours, and many are doing it with the technology we have developed over the years.

Are we going to run into the same thing? I am not against cooperation in space; I am just asking about our future. Are we going to run into the same thing?

Dr. Press. That is why I prefaced my remarks by saying that we want to maintain a strong, national program.

Mr. Winn. Yes.

Dr. Press. It is for reasons not only of national prestige, but commercial advantages. We want to be an independent, strong force in space, as well as pursuing international efforts. One reason that we have supported the reentry of NASA into communications technology is to prepare the Nation for the next generation of space technology. This is where enormous improvements are possible, and to prepare our own country and industries to be commercially competitive in this next generation of communications technology. There are other examples. I do agree with you that the possibilities, the commercial possibilities, for space systems are enormous in the future. We want to maintain a major position in this area.

Mr. WINN. Thank you very much.

Dr. PRESS. Thank you.

Mr. FUQUA. Mr. Flippo?

Mr. FLIPPO. There is concern that the manifestation of the administration's balance in the space program, in its concept, results in supporting new starts, such as GRO and NOSS. It seems there is little emphasis on what the Nation's needs will be in the future.

Now, recognizing the Shuttle development will take about 10 years before the first flight, don't you think the administration should be providing substantial funding and substantial focus on systems which will increase man's presence in space?

Dr. PRESS. If you mean that the Shuttle technology should be an evolving one where man's ability to use the Shuttle and to do things in space will increase in time beyond what we can do in the next few years, I agree. However, if you mean man's position in space in the sense of colonization of space or planetary exploration, then I think that is premature. I would like to learn as much as we can by fully exploiting the Shuttle and all of its future possibilities before we make the kind of commitments to the large-scale, man's presence in space. That we should be doing in the next century.

Mr. FUQUA. What is your time limit? I know you said 11:15.

Dr. PRESS. This is an important hearing. I would like to stay as long as you need me, but I have people waiting for me as of 11:30.

Mr. FLIPPO. I will be very brief.

Mr. FUQUA. Go ahead.

Mr. FLIPPO. I am specifically not talking about colonization at all. It is not that aspect of it at all. Back in 1971, the administration selected the Shuttle over the space station as the new national effort. The space station was deferred. Do you believe the needs identified at that time for the space station are valid today?

Dr. PRESS. I think we made the right decision in going with the Shuttle. I think you should ask Dr. Frosch to look ahead as to the ultimate capabilities of the Shuttle system, with the new system, for working in space. I think you will find that a very exciting story. The Shuttle program as we see it, next year with the first flight, will be extremely modest compared to the ultimate capability of the space transportation system. I consider that a major avenue for technology development and man's increased presence in space.

Mr. FLIPPO. Thank you, but I would just like to ask one more question.

Do you believe it timely for the adminsitration to initiate a broad review of the national need for increasing man's presence in space beyond the Space Shuttle and Spacelab, and such a review would not consider all aspects of the space program policy, such as the review you had last year, but essentially it would be to focus on the need for increasing man's presence in space and the activities which would require man's presence in space?

Dr. PRESS. That might be an interesting thing to do because I think you are talking about what kinds of projects should we be looking forward to in the next 10 or 15 years. We need to start speculating about what the possibilities are and to discuss them with this committee and with others.

I believe Dr. Frosch has programs like this going on all of the time. That is the only way NASA maintains its technological lead—by looking ahead—I just attended a meeting sponsored by the NASA Advisory Council at Woods Hole in Massachusetts. Some of the most forward-looking thinkers in American technology were there. Dr. Frosch said look ahead 10, 20, or 30 years. What should we be doing?

Mr. **Flippo**. But I see funding for things such as the advanced programs all over the board is mostly down. It is that kind of sustained funding that is going to produce the program which will do this for the future, is it not? Yet the support seems to be in a downward trend.

I wanted to express my concern.

Thank you, Mr. Chairman.

Mr. **Fuqua**. Thank you for appearing, Frank. We are sorry to keep you so late.

Dr. **Press**. It is always a pleasure, Mr. Chairman.

Mr. **Fuqua**. Thank you very much. This is a subject of great interest to us.

Dr. **Press**. Thank you.

Mr. **Fuqua**. Now, Dr. Frosch, how useful has NASA's 5-year plan been for charting the course of the agency and planning specific space programs?

Dr. **Frosch**. In this last year, we have tried to do a 10-year look-ahead, and it gets a little fuzzy. The process of constructing these plans has been extremely useful. I do not know whether the plan as a document is so useful to us, although it has had some interest and usefulness to outsiders. What it means is by going through the planning process, when we come to look at the program for a given year, we can discuss the alternatives in a longer and larger context. That has been very important to us. It has been extremely useful in that way. Along with the kind of innovation examination meetings that Frank Press just referred to, we have been trying to expand our ideas about what future programs might be and to better understand the justifications for various ideas.

Mr. **Fuqua**. If decisions are made to go ahead with large space structures, do you think the lead agency should be NASA, or should it be the Air Force?

Secretary **Mark**. I think the current situation is one of what I would call development rather than application.

Mr. **Fuqua**. I was speaking of development.

Secretary **Mark**. There are technical problems on how you unfold things and how you take care of thermal differences. Those, I think, are best handled by NASA. I think the group that has been put together at Langley and elsewhere in the agency is very competent.

We use their stuff. It is interesting. When I go to our contractors, I will see contractor proposals that are based on work that the Langley group has funded. Those are examples of technology transfer directly through the contractor. It is the same people who do the work, for both NASA and DOD.

Dr. **Frosch**. We are operating on the assumption that we have the responsibility for the large space structures technology development and for questions of the power and material utilization in space, whether they are terrestrial or extraterrestrial. As those technologies begin to be available, they will be available essentially in the sense of all of NASA's customers. It will be included to other departments of Government, not just the Department of Defense. That is a type of a continual flow. We take it that we have that responsibility. I do not know of any case where anybody has questioned that.

Mr. **Fuqua**. Thank you.

Dr. **Frosch**. Yes.

Secretary **Mark**. Yes.

Mr. **Fuqua**. The President's base policy states:

> As the resources and the manpower requirements of the Shuttle development phase down, we will have the flexibility to give greater attention to new space activities, continue programs at the present levels or contract them.

We touched on this a few minutes ago and Frank had indicated that you might be a good one to answer that. What programs would you recommend for future direction of the space program?

Dr. **Frosch**. I will put my fiscal year 1982 budget into OMB on the 15th of September. Some of the directions are clear programmatical. In science, we have a three-fold continuing program thrust that you know of. It is the planetary exploration, deep space astronomy, and astrophysics, et cetera. The competitors in the sort of science or the planetary area, or rather the principal questions have to do with VOIR that Frank had mentioned and with the question of several possible options for a planetary mission. Those seem to be the most immediate new starts in that area.

In the area of astrophysical questions, there are a number of possibilities. There are some solar and some X-ray systems that will be next on the list. There are some important possibilities in plasma physics of the Sun's influence on the Earth, which are options.

In applications, we are very much concerned about the transition to operation in land remote sensing and with getting NOSS started and pushing on with the communications system. We also want to do important continuations and increases in the zero-G materials processing business. We have put a good deal of effort into looking at the question—and this is somewhat longer range—of the usefulness of extraterrestrial materials, such as lunar asteroids or other materials, in terms of how they could be used. Also, the robotic technology, although that is a catch-all word, but certainly the automation computer technology, might be used to make that kind of thing and the use of the off-Earth solar energy and economic propositions. One has to be careful in talking about what is meant by an economic proposition. So there are those principal thrusts.

In the matter of technology and building on the Shuttle, the principal immediate concerns have to do with increasing the power availability to the Shuttle system in order to accomplish some of the other purposes; also in building up both the satellite maintenance and operational capability on orbit, and the structural expansion capability. I put it that way, Mr. Chairman, because there are a number of ways to go about that, including construction and assembly. We distinguish between construction and assembly, depending on whether you have premade parts or basic materials. Also, increasing our ability to bring prepackaged parts and to have those, that is a technology development. Beyond that and building on that, we are looking at what the whole role of platforms of various sizes will be. Let me distinguish between a platform and a free-flier by saying that a free-flier is something that we can bring up in the Shuttle complete; whereas, a platform is something we have to assemble. It will be a larger and more complex object. We are trying to understand the role that they might play in communications, in applications, and in scientific instrumentation. We are looking at what we believe the evolution of longer manned stays in low and then high Earth orbit might be, both in terms of the requirements and the specific proposals that are being generated internally and externally for particular ways to go about building such systems.

We are looking at what are really engineering sketches and proposals for how one evolves from this into that. Some of those things are clearly going to happen in this decade, and they will begin to appear in the program over the next several years. I am not as pessimistic as Frank seems to be about the time scale on which this will be ready and where it will be sensible to do some of these very large-scale human operations. It is not necessarily the next century or that far into the next century. There will be an evolution technology and capability that can be faster than that. All of those evolutions really depend on the Shuttle capability. Which is where I spend more of my time worrying although I would prefer looking at long-range technology.

Mr. Fuqua. NASA had a symposium recently. What were the results or recommendations of that symposium?

Dr. Frosch. We had one last year and one this year. There was a diversity of ideas suggested. I can run through a few of them.

There was a group that had just the general charge to consider the question of the human role in space. That was purposely cast as an ambiguous question. They chose to look at it in terms of their views of the long-range perspective of people in space. They came to the same kind of conclusion that previous groups that looked at that question came to. It is, namely, they are sure it is inevitable, that as we move out increasingly and do things in space, that they cannot, more than anyone previously, define precisely how that will take place or why. They feel that it will and there will be no major obstacles.

There was a group that looked indepth at the question of the application of space to the climate in terms of both the understanding and to the long-range possibilities of the manipulation of climate, that is, if we can understand it enough that we dare do something.

Mr. Fuqua. You have not manipulated it this year, have you?

Dr. Frosch. I hope not. I do not think anybody would want that responsibility.

Mr. Fuqua. Please continue.

Dr. Frosch. They came out with several important points. One is a feeling that some of the chemical measurements being made from the ground on certain assumptions about the fact that they are the same everywhere, that they probably need to be made from space. We need to look at the carbon dioxide problem, in particular, in a more detailed way than we have before. That will have to be factored into the program. That sounds like a small technical point, but it may be of considerable importance in understanding where we are going in the climate business. They also looked again, as we have from time to time, at the question of what scale of engineering endeavor would be required if one did want to influence the climate, for example, by manipulating the amount of solar energy that reaches the Earth. Once again, it looks like a very gigantic kind of project, and not one that we could undertake right now, or even when. At least we have some idea of what would be required.

There was a group that looked specifically at opportunities for solar science and the understanding of solar-terrestrial relationships. They came up at the time with some rather interesting brand new ideas for looking at the Sun and at the Sun's properties, and the question of whether the Sun changes in time in a long-term way. There has been some evidence produced in the past year or two that suggests that the whole energy production and the size of the Sun may be changing. There is some evidence that suggests that that evidence is wrong. It is an open and obviously very important question on a long-term basis. Conceivably, if there are certain kinds of fluctuations on a short-term basis, new ideas were brought forward as to how to deal with that kind of measurement. One of them is a suggestion that we need a long-term data-taker on the Sun. We need a century's worth of data. That may not affect what we do this year or next year, but if we started a century ago, we would have a century's worth of data. In fact, there was a start on this in Britain a century ago, but that program only lasted 5 years. So we do not have a century's worth of data. There is a suggestion that a satellite be designed specifically for the purpose of lasting 100 years and taking only that data required for these measurements. It would not only beam it to the ground, but it would store it. If people lost interest for awhile and suddenly wanted the data, they could call for it.

There were a number of ideas that, in fact, are truly new. They would be on all scales and would affect the way that we will go on with our programs. There was a set of ideas that are so speculative that they are of no interest or are so important they are of a great deal of interest. There has been a paper in the past year or so that suggests that certain geological events which were very important in evolution, such as major extinctions, the extinction of the dinosaur, for example, that they fit with some geological data and some astronomical data that suggests it is just possible that a large meteorite or an asteroid produced a catastrophic event. The probabilities of such an event from what we know are such that it is not very frequent. One measures the frequency in millions or hundreds of millions of years for certain kinds of events. It is not impossible.

The suggestion is that we now have an astronomical capability so that we could take a census of the bodies in the solar system that are capable of producing such a catastrophe, which, while infrequent, is large. It is one of the risk situations in which the event is very improbable, but the consequences are awful. You do not know quite how to treat it. It would at least be worthwhile, they felt, in taking a census to find out whether this was an event which was more or less probable, and in the very long-term whether it is worthwhile examining the question of whether there was anything we could do about it, if we saw it was going to happen.

It is farfetched, but not ridiculous. It is certainly worth examining. The suggestion for detection is certainly worth looking at because that might be cheap, simple, and useful to know, or at least scientifically if not in terms of whether there really was such a thing.

There were several suggestions that we had heard about, but had never looked at in detail. One is more detailed suggestions on the possible use of beamed energy or laser energy. This would be to provide rocket propulsion. We get fairly fat menus of new ideas and new things. We go back and feed them into the program; and they affect our plans.

Mr. FUQUA. Go ahead, Mr. Flippo.

Mr. FLIPPO. Is it out of order for me to ask the Chair not to ask such long questions?

Dr. FROSCH. My apologies, but I would be happy to be interrupted in answering. I try to give a complete answer.

Mr. FUQUA. It was a very interesting answer.

Mr. WINN. You beat me to it. I was going to ask him to repeat that.

Mr. FUQUA. Go ahead, Mr. Winn.

Mr. WINN. Bob, in your statement you said the key to implementation of space policy is NASA's research and technology base.

Dr. FROSCH. Yes.

Mr. WINN. You said for several years we have watched the manpower ceilings being reduced and the hiring freezes instituted. As a result, the average age of the scientist and the engineer continues to increase.

In my opinion, there seems to be a little conflict there. If the administration is serious about their policy, then why is this allowed to happen?

Dr. FROSCH. We have been trying, with reasonable success, to use the fact that part of the NASA work force has been aging enough that it is retiring which opens up some billets. We have tried to concentrate as much as we can on the entry level hiring and on the replenishment of the whole spectrum of ages within the agency. If you look at the age spectrum in the agency, you will find it has two peaks. There is a peak of people who are basically those who came from NACA and came into the agency early in Apollo. There is a peak of people who began to be hired later. There is kind of a gap in the middle of the age spectrum that we have been trying to smooth out by our hiring policies. We still can hire good people, although the salary disparity at entry level between the Government and the relevant engineering industry is getting to be a serious problem.

In the past 2 years, we have been fairly stable in our ceiling. I hope that we can maintain that or possibly increase it, at least in the technical part of the base. I am not sure that is likely to happen. The freeze has probably in the end not prevented us from keeping the ceiling. I am not sure how it will come out, but it turned out that we had enough retirements and attrition so that even with one for two, it will probably turn out that we are probably maintaining our technical base, as we should.

In the view of the Congress or the public, this is not a time to talk much about increasing the civil service. Our part of it is a technical national asset and one that we have to continue to worry about.

Mr. WINN. Yesterday, our witnesses said they felt the priority mission after the Shuttle would be a man-based station. Briefly, how do you feel about this?

Dr. FROSCH. It is the most likely next step into which we must involve in a technology way. This is for a variety of reasons. One, we are going to have Shuttle-based jobs to do in applications and science that will require this. Two, we will need this as a base for doing any of the larger things that we want to do beyond this. I think that is probably the next one.

Mr. WINN. What effect does broadening NASA's charter into areas such as auto R. & D. have on the long-term future?

Dr. FROSCH. To a reasonable degree, it has been useful for us and useful for the country for us to be able to use some of our technology and technical talents on the other problems. We have to be careful how we do this. We have, in the case of at least one center, agreed with the Director on the amount of the center's resources that may be applied to tasks other than space and aeronautics. Because we need to keep our capability, we do not want to have part of the organization turned into a technology group of a different kind. We get something out of it, too, because we get contact with other areas of technology which is stimulating and everybody involved likes the idea of contributing to the national priority area. This is something we have to approach with care, and we have been trying to keep an eye on this very carefully so that we maintain our capability.

Mr. WINN. I have been to several of the centers. I have seen some of the work NASA has done, and it is cooperating with other organizations, such as the University of California, I believe.

Dr. FROSCH. Yes.

Mr. WINN. Through the NASA operation and expenditures, have they developed anything in the automobile R. & D. that you think is being used now or can be used in the immediate future by the industry, or is the industry doing most of the work that is being done?

I truthfully have not seen much coming out of the NASA part of R. & D.

Dr. FROSCH. Most of the NASA automotive R. & D. has been concentrated not on near-term improvements to existing automotive systems, but on possible exotic or different engine systems that would not be intended to come into use right away, such as turbine engines where new engineering systems have got to be developed. There have been some areas in which there is beginning to be some use in the industry. One is an old story already, which is the use of small computers for control purposes in automobiles that is beginning to happen. Probably the biggest next area of technology transfer will be the use of composite materials, as we have moved them into aircraft. They are beginning to be used quite extensively in automobiles. I think that is likely to happen over the next several years. Some of the battery improvements will probably come into use.

Mr. WINN. Dr. Mark, in recent years, DOD's space budget reached a level that is equivalent to the civil program. What effect do you think this has on the world's perception of the American space program?

Secretary MARK. I can best answer that by not talking about the world's perception because I cannot grasp that. But I can talk about the perception of the Russians. The Russians have developed an antisatellite system. They have paid for that development.

That tells me that they think what we are doing is valuable. Otherwise, they would not try to deny us the systems. I think their perception is that our dependence for our national security on our space systems is very heavy. Thus, it makes sense for them to develop this threat.

Mr. Winn. Yesterday, I discussed with witnesses the problems associated with declining world leadership in space. In your testimony you refer to it several times. I notice that you stated our leadership is tied to the Space Shuttle. The Russians do not have anything like that.

I wonder if you would elaborate a little bit more on defining our world leadership in space.

Secretary Mark. I think the Shuttle is the centerpiece here. Once again, it is interesting that the people that made that perhaps clearest are our Russian friends. During the negotiations we had with them on the antisatellite treaty, they followed only one thrust—to try to limit by treaty the operation of our Shuttle, even though it is not an antisatellite system.

That is their judgment as to what they are afraid of, and what I think is needed to maintain our leadership.

Now, in terms of scientific results, I think Frank Press already mentioned that all of the really major discoveries in planetary exploration have been ours. I think there has been only one successful planetary exploration program the Russians have won; that was the Venus program. They have done nothing on the outer planets, such as Jupiter and Saturn. Their Mars program has been a failure.

Mr. Winn. They have not developed the capability of a tremendous thrust.

Secretary Mark. They have vehicles with great payload capability, but as far as we know, they do not have anything like the high-pressure oxygen engine in the Shuttle.

Mr. Winn. Is that not the same reason they have not landed on the Moon?

Secretary Mark. There is some dispute as to that. My own judgment is they made a try at it. They had a couple of failures of their large launch vehicles in the mid-1960's, and they gave up.

Mr. Winn. It does not sound like them, but you are probably right. They may have changed directions.

Secretary Mark. Yes.

As to their defense, let me say that they had had a very strong and sustained program, in the sense that they fly a lot more spacecraft than we do. Last year we had, I think, 35 launches. They had over 100. They do find more things than we do. On the other hand, the things that they fly do not last as long as ours.

Mr. Winn. Basically what they are doing would be more of the things they have done before, and there is a little PR by incorporating Czechoslovakia with their cosmonauts.

Secretary Mark. They have a more evolutionary approach than we have. Our Shuttle is truly a departure. It is a high risk venture, but one with a payoff.

Mr. Winn. In your statement, you gave several examples of cooperation between NASA and DOD. The examples seem to be of NASA using DOD technology. Isn't this a two-way street?

Secretary Mark. Yes. I thought I mentioned the wind tunnel, the multimission spacecraft, and other things, the composite materials.

Mr. Winn. How often do the DOD guys get together with NASA? Is it every day?

Secretary Mark. In Washington I talk with NASA people—including Bob—fairly often.

Let me give you an example. The Army's Aeronautical Research and Development Laboratory is located at NASA's Ames Research Center. There are 250 employees of the U.S. Army doing helicopter research at Ames. They are integrated into the center and use the Ames facilities although they are part of the Department of Defense.

There are joint projects, such as the tilt rotor aircraft. Those of you that serve on the Armed Services Committee know that is a strong player in the V/STOL program.

I think the collaboration I have seen at all levels has been close. It's continuing; it has been part of the long tradition of this Nation's policy. For example, under the National Advisory Committee for Aeronautics, of which NASA is a successor, two statutory members of the committee were the head of the U.S. Army Air Corps and the Chief of the Naval Air Service. It goes back a long way.

Mr. Winn. Here is one that you can answer and then maybe Bob would want to give his version, and this is my last question.

Can you envision any circumstance where the goals or the objectives of the civil space program may compete or conflict with the military?

Secretary Mark. I have to admit I have not thought about that. I do not think I can envision such circumstances. I might write you a letter on that, but on the spur of the moment nothing of that kind comes to mind.

Mr. Winn. That is a pretty tough question. You might talk to some of your people. It is a subject I think we should know more about.

Secretary Mark. Let me think that over. It is an important question.

Dr. Frosch. One area where we could face some unusual problems, is an area in which if there were an interest in taking scientific data of that kind, one would be taking information with the military. Then there might be a question of how to handle that data for dual use. This may one day arise in the remote sensing kind of context where for remote sensing purposes one has no interest at all in certain kinds of information. Yet, it is hard to take basic data without getting information which is of political or military significance. If the military side wanted the military information and did not care about the application, or vice versa, then we might get into that kind of a problem. That is the essence of some very high-level policy kinds of questions. It is not so much a conflict between the goals as a sort of collision of an actual situation.

Mr. Winn. Do you think that gray area that you mentioned is something you might want to start discussing?

Dr. FROSCH. It has been discussed in principle. This is both between us and at the national level at the National Security Council.

Secretary MARK. I could have answered similarly. I did not use that example because I felt your question was looking for things that might hinder what we would do. It has not hindered us. Where we have had this problem, we have talked about it and arrived at accommodations. Therefore, while that is a question that comes up at the meetings, it has never hindered the programs.

Dr. FROSCH. It has not hindered us. It is a problem we have had to deal with.

Mr. WINN. Thank you.

Mr. FLIPPO [presiding]. Go ahead, Mr. Brown.

Mr. BROWN. Now, Mr. Chairman, I am very much interested in the applications program, particularly as it involves communications and remote sensing. I do not think we will have time to explore fully all of the aspects of this, but perhaps we will later have other opportunities.

Let me first ask Dr. Frosch a question that stems out of the testimony of Dr. Press. Dr. Press said that through NTIA awards were being made and grants were being made to the grantees to develop or stimulate the public service use of satellites, these being the Appalachian Network and Bell and Howell public service and the Bell Lab and so on.

It has never been clear to me the degree to which NASA should be responsible for stimulating this kind of user planning type of activity. NTIA, as far as telecommunications is concerned, is the logical group to do that. They would not be, for example, interested in the applications of remote sensing or that type of activity.

My question essentially is how do you work with NTIA on a program that they are involved in here or what do you do on your own to stimulate the clarification and the development of program goals, such as long-range market development that we are talking about here toward some of the applications of space technology which have very high potential for development.

Dr. FROSCH. Our working arrangement with NTIA is essentially directly between our communications people working with them, in part, as technical advisors on satellite communications. But to the main point of the question, we have had, in remote sensing and before this in communications, active programs in which we seek out the potential users of the technology, and have arrangements whereby they can seek us out, to try to define with potential users problems which the technology and the system in question could contribute.

We work up demonstration projects. They really start as experiments, and they end up, if successful, as experiments and then demonstrations in which one can actually have a field or pilot project with the user. This is to define the application and to apply it with real data in the field. There is a long history of these. In fact, that is what has led to the ongoing effective operational uses in both remote sensing and communications. For example, in communications as a result of some of the earlier work, there is a jeep communication in the Air Force that uses the old ATS-3 satellite. As part of the Mount St. Helen's emergency, the Federal Emergency Management Administration arranged through us and the Air Force to use that jeep and ATS-3 to do operational communications from the Mount St. Helen's area, partly because they needed it and partly as demonstration work. There is a good deal of direct field operations with potential users.

Mr. **Brown**. It is a jeep that is mounted on a receiving dish?

Dr. **Frosch**. A small antenna that you can talk to. You can talk back and forth to ATS-3. In that case, there was a net set up from that particular field installation effectively through ATS-3 to Washington and other places for direct field use.

Mr. **Brown**. I think you understand the essence of the problem that I perceive in this technology development. For example, with the electric utilities expanded, there were vast areas of our agricultural low density areas that were the last to be served. We had to ultimately end up creating special institutions to serve them, such as the National Rural Electrification program and the telephone program and so on.

I see this trend as the technology increases and the capital requirements become larger. Some portion of the market is underserved because they are unable to get their act together. They are impoverished or whatever reason. And there needs to be a public policy decision as to how to maintain equity of service in the new technologies in these kinds of markets.

I am aware of the fine work that NASA has done with the various experiments and as to how some aspects of the market could be served. But what it generally boils down to is the amount of effort.

The NTIA announcement of the four grants—and I do not have the grants before me, but I would be very surprised that if in total they amount to more than $10 million. I would be surprised. That is so ridiculously infinitesimal as compared to the needs of this vast unmet market that, in effect, they are being deprived if that is going to be the level of our effort, despite the technical demonstrations of the utility of some of these technologies for providing medical services in remote areas and educational services and linking libraries and whatever needs to be done.

I am concerned about how we meet that problem. I suspect you do not feel that is high on your priority list of problems to be met.

Dr. **Frosch**. It is something that we have worried about considerably. That is the transition to operations. The difficulty is that it is so very clear that we have neither the authority or the responsibility to carry out those operations, particularly in areas like public service communications. We have only in effect been able to help with a transition to whatever operational system is set up. Usually the economic scale that is required for an operation in some area like that is far beyond even the research and development economic scale, and a different kind of national decision has to be made. It is like the REA kind of decision.

Mr. **Brown**. I understand your answer, but I am still not satisfied as to how we are going to meet this need. If you have any thoughts on that at some point, I would appreciate receiving them.

I know in the case of REA, there were large amounts of capital made available at low-interest rates. Special banks were set up. A lot of provisions of that sort were put into place.

At the minimum I think we ought to be considering whether or not some similar level of effort ought to be made in insuring that the fruits of this investment and in this base technology be made available to the public that provided the money for it on some sort of basis. I get a little worried sometimes if we are not looking at the problem from that standpoint, quite obviously because many large organizations which do understand the importance of this do move in. They develop markets, and they serve those markets very well. This is because they are very profitable.

They still for the sheer reason of possibility do everything, but it is their job to go in and create new institutions, to provide a service where it does not exist.

Dr. **Frosch.** There may be some special opportunities with regard to the space systems. This is because so much of the investment is in the space segment that if you have a situation in which some of the larger users need to invest in the existence of the space segment, then it may be possible to add smaller users on the ground to essentially piggyback on that investment, using much smaller investments marginally on the ground. That may be the case in some communications, although it has not become quite apparent yet, it will be the case in the use of remote sensing.

Mr. **Brown.** Thank you very much.

Mr. **Flippo.** Thank you very much.

Gentlemen, thank you very much for your testimony.

We will adjourn, and we will reconvene at 2 p.m. this afternoon here in room 2318. Then we will hear the testimony of Dr. James C. Fletcher.

I will also announce there will be a briefing on Landsat at 3 p.m., which is open to the public.

Thank you very much for your testimony.

AFTERNOON SESSION

Mr. **Fuqua.** This afternoon the Subcommittee on Space Science and Applications will conclude hearings on the Nation's civilian space policy.

We are, indeed, pleased to welcome Dr. James C. Fletcher, formerly NASA Administrator, to these hearings today.

Dr. Fletcher, we look forward to receiving your testimony. It is very good to welcome you back to the place that you have been many, many times under different responsibilities. We are happy that you can join us to give us your thoughts on our civilian space policies.

STATEMENT OF DR. JAMES C. FLETCHER, BURROUGHS CORP.

Dr. **Fletcher.** Thank you, Mr. Chairman.

It is indeed good to be back in this most famous room. I appreciate your giving me the opportunity to pass along my comments on the Nation's space policy.

If it is all right with you, what I would like to do is submit my testimony for the record and pick out some of the highlights and allow time for questions.

Mr. **Fuqua.** Certainly. We will make your entire statement part of the record and you may summarize.

Dr. **Fletcher.** I think the part I want to skip the most is the part dealing with some of the problems we had with the Space Shuttle developments, and then I can get on to things that I think were good that came out of the Shuttle program.

That would start on about page 4 of the testimony.

One of the things that we did properly during the Shuttle period was to put together what we call the balanced program. We still call it a balanced program, which I think is healthy.

That is to establish an appropriate balance between the manned space program, the space science program, and the space applications program and the aeronautics program. As a matter of fact, I think that we did that very well, at least in the case of aeronautics and applications.

Both of them actually increased during this period, even though the Shuttle had absorbed the larger amount of the funds.

I would like to say that during that period, science, except for the Viking program, was slighted somewhat. We did have a science program and a healthy one, I think. But lately, Mr. Chairman, especially we did begin to cut back on the planetary and the space science program.

I think at this point, amazingly, as it may seem, if you look at my past testimony, I think science should receive more emphasis than other parts of the program.

I, for example, think that we live in a solar system now. It is not just the planet Earth. We need to understand how Earth fits in with the rest of the solar system. We need to systematically look at each of these planets and gain a better knowledge of what our home really is. You might say our home is the galaxy, but I think it will be some years or a century before we ever move out of the solar system. So I would tend to emphasize science, especially planetary and I would do this despite the fact that it might seem self-serving. Although I am not presently involved in any space science program; I have been a scientist all of my life.

I think the public wants to know what is out there in our own solar system. I think they need to be more actively involved.

I remember in this very committee some of the members gave me a bad time because we did not have better public information programs. I feel very strongly that we do need not only a public information program, but to actually involve the public in a number of ways, which are crucial to the moving ahead of this science and exploration program.

I think our planetary probes and, whenever possible, our low altitude science satellite systems have to display visual data. Even when the data comes in in exotic scientific forms, it needs to be presented to the public in a way that they can actually see what is happening, such as magnetic fields visually displayed and particles visually displayed.

The second thing I think we need to do in order to involve the public more is to give them some better feeling of what the science program is intended to do. What are we aiming at in this exploration of the solar system and the universe?

There are such programs as Nova on public television that do that very well, but I think a much larger segment of the public needs to be involved than the segment that is involved in public TV only. That is going to take a lot of talent, but I think it has to be done.

Last but not least we have really got to involve other people in other disciplines. I think novelists and motion picture producers, journalists and even poets need to be more heavily involved in space adventure. As a matter of fact, you will find, I think, if you ask writers, poets, and people like that, they are sold on the space program. They cannot understand why we do not move along faster.

I think the problem is that scientists kind of look down their noses at the other disciplines, and it is really their fault that we have not done better with the communicators of this world. Scientists are notoriously poor communicators.

I think public involvement is a crucial point of the science program. That is not the only reason that we should pursue science more vigorously. I think the spinoffs are enormous, in spite of the fact that we used to talk about technology spinoffs—and they are real. There are long-range spinoffs that have to do with understanding our own climate. We could never pursue the climate program that we are now doing rather well, but slowly, if we had not had the background and experience from the other planets.

Another example is that the first steps toward understanding the ozone layer were all done by planetary scientists who discovered similar effects on Mars and Venus.

We are more recently concerned with the CO_2 problem, the burning of fossil fuels which may very well be a terrible problem. We may be forced to quit burning coal oil and natural gas if it turns out that carbon dioxide in the atmosphere has the predicted enormous effect upon the climate.

There is an event more recent that is just beginning to occur among the scientific community, that is, in studying other planets and looking at them. In the early formation of the planet large amounts of carbon were present. We are beginning to wonder what happened to all of that carbon.

There does not seem to be enough in the atmosphere or in the Earth's surface. We are beginning to speculate that a lot of that carbon is in the form of methane which is deep down in the Earth's surface. Perhaps it is as shallow as 10 kilometers or so, but probably deeper. We notice it coming up through the Earth's surface during earthquakes or volcanos.

This is nonbiological methane. If this turns out to be real—and I will call your attention to the June issue of the Scientific American magazine where there is a very good description of the process—it is by two planetary scientists—this discovery could pay for the space program, the entire space program, many times over.

Now, skipping along, I do not think I will address the question of space solar power. I do think after science I would emphasize the new Shuttle applications, that is, applications peculiar to the Shuttle.

This would be contrasted to the Landsat or those programs underway, which are good, but which cannot be done without the Shuttle. Space platforms are examples of that kind of a program.

A space platform could be built rather cheaply if we turned our mind to it. We could design one that could be done for a fraction of the cost of the Shuttle, and it could be evolved into a larger program.

The question is always asked, and it always puzzles me why, which is, what will you do with the platform? The trouble is there are so many things you can do with it, that it becomes lost in the "many" instead of the "one."

Certainly it would be a stopping off place if we decided to go back to the Moon. It is a place to store fuel. It is an observation platform. It is a place to do experiments. It is a place where we could begin construction of large facilities, and some day it could be a place where we establish the basic elements of a space colony.

I do want to emphasize space colony studies. I was very disappointed to find funds for that program were cut off. I think we were the first ones to get to the Moon. There are resources on the Moon. We ought not to give up that advantage that we have. We ought to use the Moon's resources to produce whatever minerals we need. The nearest term thing possible seems to be to produce energy on Earth by building a colony at La Garangian Station Stable Point No. 5.

I think I will skip along as to the part about space applications because I think that has been well covered in the rest of your hearings. I think the applications program has been going rather smoothly. I am very pleased about it.

I would like to emphasize another aspect of the space policy which does not seem to come up very often. That is that NASA is really the only future-oriented agency in Government that is a long-range future oriented, not a 1-year plan. In NASA we have to look 20 years ahead to be able to come up with a reasonable plan.

If it had not been done, we could never have gone to the Moon. I really feel that some of our Congressmen have been hampering those long-range programs. Richard Atkinson, the recent Director of the National Science Foundation, indicated he thought the Senator from Wisconsin was quite supportive of the science program. I think he was also. He was also supportive of the space program when it was near term. I think he did a great disservice to the country, however, when he poked fun at the program on which we call "the search for extraterrestial intelligence—SETI. That seems to the public pretty far out. I agree with that perception; it is far out. But if we were successful in contacting intelligent life out in the universe, it is unimaginable what the impact would be.

For example, most scientists or I would say by far the majority of the scientists are absolutely convinced that there is intelligent life in our galaxy. I am not going to quote from all of them, but I did pick up some quotes from a couple or three of them. I will leave this in the record, although I do not have a large number of copies.

Let me just quote from George Wald, the Nobel Prize winner, a biologist from Harvard University: "I think there is no question but that we live in an inhabited universe that has life all over it."

And Kenneth Weaver says: "With our rapidly growing understanding of the universe has dawned the profound belief that we are not alone. It is a belief that life exists outside our own tiny corner of the cosmos, and it is growing strongly."

And Isaac Asimov, as one who is a real scientist, although he is better known as a science fiction author, he wrote my daughter's textbook in chemistry said: "If we ever establish contact with extraterrestrial life, it will reveal to us our true place in the universe and with that comes the beginning of wisdom."

I think those are true statements. It is hard to put a price tag on what would happen if we were able to contact the folks outside our own galaxy. For that reason, it is not wise to invest a large amount of money at this time.

On the other hand, I think it is wise to continue to look at the problem and devise less expensive ways of establishing contact with these other intelligent beings. But to make fun of such a program is really the wrong way for our country to go. We do spend a lot of time worrying about not very likely accidents, such as nuclear accidents.

A lot of time and effort is spent, and it costs the country a great deal of money. We do not look at the other side of the coin, that is, investing similar amounts of money taking opportunities of things that may be unlikely or less likely, but where the potential payoff is enormous. It is backward from the song when we say "accentuate the negative and eliminate the positive." That is not the way our country should go.

That is a comment on future programs. It applies more than just to SETI, but to a number of them.

There is one other point I wanted to make, and which I think I may come in conflict with some people who have appeared before you. That is the possibility of pursuing the high challenge technology programs.

I think it is absolutely wrong to say that large high technology programs are "premature and infeasible." That is just wrong. It is probably unwise in this particular year, when the country is going through some very severe economic difficulties, to start a program that is very large and very high challenge.

That does not mean we should not start it as soon as we recover from our economic difficulties. I completely agree with former Secretary Blumenthal that inflation is our No. 1 problem. The underlying inflation will last apparently for years, and this is a major problem before us now.

To start a new high technology program this year would be unwise. The public would have a hard time understanding why we would do that. It has nothing to do with being "premature or infeasible." I think that as soon as we make a little recovery from our economic situation that we have to start looking at all of the programs, all Federal programs across the board, and ask which of them have more inflationary impact and which have less.

I am quite sure that it will come out that most of the space programs or almost any of them have not only a low inflationary impact, but they actually improve productivity and thereby reduce inflation.

We made studies on that. The studies were very crude. There was a lot of criticism from some sources. I think basically the conclusions were right. We need a lot more work to prove they were right.

Now, to move on to some of the issues that you had raised as far as space policy is concerned, I think the institutional base erosion in

NASA is a very bad thing, but I do not think it can be resolved without a cooperative effort between NASA, the Congress and OMB. I think it is almost criminal, for example, the way that we have attrited the manpower year by year. That is just wrong. It is demoralizing. It gives the program a bad name. It causes people back at universities to say, "I do not want to go into that field." So this causes a severe manpower shortage.

If you want to cut the institutional base, make one big cut. Then leave it alone for awhile so it has a chance to stabilize. The way we do it year by year, a little at a time, is not the way to build a strong institutional base. I am very concerned it has eroded so seriously since I left, which is only 3 years ago.

There is one other thing, Mr. Chairman, that was raised by your group. That is the idea of closing a center. That always came up when I was at NASA. Different centers were picked, and which one seemed right politically was the one.

I do not think we need to close a center. We obviously need the three manned centers, Houston, Kennedy, and Huntsville. This is to carry out the manned space program. We need the aeronautic centers, but that is not the subject of these hearings.

I also think that we need the two science and applications centers at JPL and Goddard. It is conceivable that you could combine those two. There has been talk about this possibility for many years, or you could specialize one with science and the other applications. I think it would have a demoralizing impact on both institutions if we try to do that. I do not see any sense at all in trying to merge an east coast organization with a west coast organization, just for the political benefit that you might get by saying yes, you closed the center.

The only possible exception I can see to that is that we could recombine the National Space Technology Lab and STL with Houston or Marshall. That is what it was to begin with, and we had political pressure to separate it. I do not see any sense in going through the agony or the chaos of trying to put it back together again.

Now, the same also holds true for technical support generally. I think it is a shame that it keeps eroding year by year. I contributed to that. It always seems that when you are squeezed on a budget, you trim the long-range programs and manage to contain the short-range programs. That is still going on.

The only way to solve that is to remove the constant pressure from the NASA budget. Give them some guidelines. Let them divide up the guidelines the way that makes sense. They can come to you every year, and you can make those corrections as you need.

I felt very comfortable with my relationship with this committee in all of the years that I was at NASA. Yes, you cut our budget from time to time, and in retrospect, we probably deserved it, but I cannot think of any place you did it improperly.

I think that guidelines are important. You must stay within the guidelines; modify them slightly. That is the way to keep the technical base strong.

In summary, I would just like to reiterate the following. I have already mentioned them once.

First, NASA should continue to be future oriented, and it should emphasize those programs that may have a positive impact on our Nation's future.

Second, we should not be afraid to undertake large, high challenge technical programs when they are warranted. I would only hesitate in this particular fiscal year because of our current national economic distress, but in normal years I would proceed whenever it made sense, and I hope that is very soon.

Third, we should not be afraid to support at a low funding level programs that relate to the distant future, but which have the potential for very large social impacts; both L-5 and the SETI are examples of such programs.

Fourth, NASA, with the help of Congress, must be extremely cautious about the constant erosion of its technical base or institutional base. Much of this erosion is the result of purely political considerations, and in the past, this technical base has been cut too deeply and too often.

Now, with the help of Congress and with the Space Shuttle nearing completion, I think NASA must move forward into the 1980's with a positive approach to its future and with sound programs in science, applications, and in human occupation of space, which will be in a way which will make the country proud of NASA and NASA's accomplishments, as well as proud of itself for having encouraged NASA to do so.

Now, Mr. Chairman, that concludes my statement: I have tried to address most of the issues that you mentioned in your letter.

There is one issue that I deliberately left out. That is the issue as to whether NASA's charter should be broadened, for example, to encompass part of the energy program. The reason, Mr. Chairman, I did not address that is I am a little ambivalent on that subject.

On the one hand, I am Vice Chairman of the Energy Research Advisory Board. I can see what is happening in DOE. It is just a shame NASA is not running some of those programs because they would not be in the terrible trouble they are now in.

On the other hand, if you took NASA's good people and move them over to run the energy program, then the space program will be neglected, just the same as the aeronautics was during the Apollo days. Even though it might be best for the country if NASA were to take charge of some of those programs, in the long range I think it would hurt the space program.

So I really have not come down firmly on one or the other side of that issue at this time. I will be glad to answer any questions, Mr. Chairman.

[The prepared statement and answers to questions asked of Dr. Fletcher follow:]

STATEMENT FOR
SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS
JULY 24, 1980

DR. JAMES C. FLETCHER

Good afternoon, Mr. Chairman and Members of the Space Subcommittee. It is a pleasure to be with you once more this afternoon to discuss with you some of my views for your consideration on developing a revised U.S. Civil Space Policy. I think it is timely that this be done in light of the recent review of the entire Space Program, Military and Civil, by the Office of the White House and coincidentally at the beginning of a new era in which shuttle problems are behind us, but shuttle opportunities are before us.

Before dealing with the problem at hand, I think it might be useful to the Members of the Subcommittee to reminisce about the time when we were formulating the current Space Program in 1971-72. As you recall, after a great deal of study and some contention within the Executive Branch, the current Space Shuttle (now called Space Transportation System) was announced. The announcement was unusual in that we gave a fixed price in 1971 dollars to complete the development program. As you may recall, this was done purposely in an attempt to maintain a relatively constant level of funding at NASA and at the same time retain an appropriate balance between Space Shuttle development and other major NASA programs. A side issue was the need for NASA to begin to think of programs as "design to cost" programs. As you may recall, the Viking, Mariner and Pioneer Programs were all of that nature and were quite successfully accomplished under this new concept.

Unfortunately, all the things that we feared about Space Shuttle development in those early days, and did our best to prevent, eventually did come to pass: that is, the constant struggle to maintain the proper payload weight margin, to prevent overruns in the program, and perhaps most important of all, to avoid delays in both the first manned flight and in the beginning of the operational system. There was only one official delay of one year scheduled at the time NASA's budget was cut in mid-year (in 1973, I believe) by about five hundred million dollars, but despite subsequent pressure on NASA's overall budget, the date for FMOF (First Manned Orbital Flight) of early 1979 was maintained. Toward the end of 1977, it began to look as though early 1979 might not be realistic although no single cause for slippage, even the engine problems, was obvious as late as 1977. In July of 1980 despite the many recent slips, however, I am optimistic that further shuttle delays will not occur, especially those that might be due to the Thermal Protection System (tiles) and I'm hopeful that any further overruns, if they occur, will be in the operational system and not be part of the development program. Also, as I understand it, the full operational payload weight will be restored when the third operational orbiter is completed.

One of the things other people feared most (however, not myself) was the loss of Congressional, or even popular, support for the Space Shuttle. This never happened. Congress, especially this Committee, rarely cut the President's budget, and when they did, in retrospect, I believe the Congress was right and we were wrong. In almost every instance, the most severe cuts in the program came from the Executive Branch, and I'm sorry to say, were often politically inspired; whenever the overall Federal budget was cut, NASA seemed to be cut by a larger percentage because as one President put it, "NASA seems to be able to absorb cuts more effectively than other agencies because of their superior management competence!" I was always grateful for the President's confidence but discouraged that we were always on the short end of the budget for reasons which appeared to be political.

The program for the shuttle probably *was* underfunded (in retrospect). Even though at the time none of us were aware of future difficulties and despite the fact that we insisted that only those cuts be made which would not cause delays in the program but were due to "improved management efficiency" or possibly slight degradation in performance, there was no way to be sure, either at the working level or at top levels, that this was being done properly. The idea of "design to cost" was good in concept but occasionally programs were eliminated, unbeknownst to most of us, which contributed to some of the delays now being experienced (the tiles being a most conspicuous example). The "design to cost" concept worked fine on Viking, Pioneer and Mariner, but turned out to be much more difficult when applied to a complex device like the Space Shuttle which requires much more careful and broader technical monitoring. I am sure that, on the next large program of this kind, much broader and in-depth technical monitoring will be done without excessive cost and perhaps will be one of the main "spin-offs" of the Space Shuttle development program.

Balanced Program

One thing that *was* done correctly during the shuttle period was the implementation of a more balanced program, i.e., the dollars spent among programs for Space Transportation, Space Applications, Space Science and Aeronautics all received appropriate funding. In fact, I believe that Applications and Aeronautics during this period increased slightly although Science probably did suffer somewhat which, at the time, we attributed to the dropoff in Viking funding. In recent years, however, I have been deeply concerned that Space Shuttle overruns and delays in shuttle FMOF have impacted Science, both Planetary and Earth Orbital, to the degree that the Science Community may be losing confidence in NASA's future prospects in these areas. I would, therefore, make Science one of my highest priorities in the years to come. I would do this not just to keep scientists interested or even to regain U. S. preeminence in this field, but rather to do it in cooperation with all other advanced nations in order to learn more of our "expanded home" - the Solar System. In addition, we need to explore our own Galaxy and the remainder of the universe to obtain a clearer picture of how our Galaxy and planetary system fits in with the rest of the universe. This would give us insight into how we came into existence and what is to be our long-range future.

I strongly believe, however, that to justify spending adequate funds in Science (and in this case what, in the public mind, would be called "exploration"), the public needs to become more actively involved in order to gain some of the same excitement and enthusiasm that scientists themselves do. Although I have spent years in the education field, I do not claim to be an expert in educating the public, but nevertheless I would think as a minimum the following steps could be taken to achieve greater public involvement:

(1) A large amount of visual data (photos) suitable for TV should be developed. This data can be collected on the experiments themselves or can be reproduced from the nonvisual data which has been returning from space.

(2) Translate into simple terms the real meaning and impact of the Scientific Programs that even non-educated people can comprehend. Much of this has been appearing on NOVA (Public TV) but we need to establish communication with a much larger audience.

(3) A large amount of interfacing of scientists with novelists, motion picture producers, journalists, poets, etc., is required. These are the people who really impact the public (perhaps even more than politicians!). These talented people are often scorned by scientists as being unteachable, but sometimes I feel it's the scientists themselves who are unteachable - they don't seem to understand the functions of the media and the Liberal Arts

community nor do they often show gratitude to the taxpayer who supports Science Programs.

The Science Program should be pursued for its own sake, i.e., for the reasons that I mentioned above, but it should be constantly kept in mind that there are myriads of "spin-offs" from any High Technology Program that NASA might undertake. For example, there is normal Technology Transfer from the Instrumentation, the new Materials, the Electronics, etc., that are required to make the Science Program succeed. Also, in recent years, there has been a rapid growth in the study of the Earth's climate as a result of exploring other planetary atmospheres. The current concern about the ozone layer, which I think is now close to being resolved, first grew out of observing nearby planets, Mars and Venus. The concern about the future impact of burning fossil fuels, which causes large amounts of carbon dioxide to be produced in the atmosphere thereby possibly profoundly effecting climatic changes, also originated from observation of the planetary atmospheres and was first noted by scientists who had done extensive research in planetary science. It is quite possible that the whole energy crisis which the world now faces could dwindle into insignificance if some of the recent theories about enormous concentrations of methane to be found deep within the earth's mantle are verified experimentally. As you know, we seem to be finding more and more natural gas as we explore specifically for methane instead of finding it only as a by-product of exploring for petroleum. Planetary scientists have wondered what happened to all the carbon that must have been present during the early formation of our own Planet before Life began. It is possible that such nonbiological carbon is completely contained in the atmosphere and in carbonates in the upper layers of the earth's mantle. However, recent theories indicate there may be vast amounts of this unoxidized carbon deep within the earth's mantle held there by enormous hydrostatic pressures. This carbon in the form of methane escapes after deep cracks in the earth's mantle, i.e., seismic disturbances several miles deep. During such earthquakes tremendous flames have been observed as the hot gas is released to the atmosphere. If, as predicted, large quantities of methane are still contained in the earth at depths which can be economically reached, the entire cost of the U.S. Space Program will have been justified many times over.

New Shuttle Applications

I would place as a second priority in the next few years "New Shuttle Applications". This includes, of course, both the traditional Science and Applications Programs, but here I would especially emphasize developing the use of the shuttle for applications that could be done in no other way. The Space Telescope is an example of such a program but two other programs immediately come to mind:

(1) The Space Solar Power System (now called Satellite Power System); and,

(2) A Space Platform.

The SSPS, as is well known, is a potential electric power source that could be available in the year 2000, and if it were to be cost-competitive, would supply all of our electrical power needs forever. This is not the place to enumerate all of the technical problems that need to be resolved before such a program is undertaken, but I do strongly believe that the technology needs to be vigorously pursued so that when the time comes to build such a system, the technology is at hand in much the same way as was the case of Apollo. Apollo could never have been accomplished if the technology of large rockets and rocket engines had not been developed during the decades preceding July 20, 1969.

Incidentally, I was quite dismayed to find that the studies made on "Space Colonization" were discontinued. The work done by Professor Garald O'Neill and his colleagues has been an inspiration to many younger scientists and, in fact, may be the best way in the long run to build Space Solar Power Stations. Furthermore, as material shortages become even more serious, mining the moon or even nearby Asteroids may not seem so wild.

In the case of the Space Platform, the program is much easier to pursue since such a Platform could be made rather inexpensively and also could be done on an evolutionary basis, using the shuttle to transport men and materials into space and gradually, as shuttle flights become more available, assembling such a Platform in orbit. The value of the Space Platform is not symbolic at all but would be the basis of nearly all future manned space programs (an Observation Platform, a Fuel Storage Depot, a Base for construction of large space objects (antennas?), the beginnings of a Colony at L5 (La Garangian Station Stable Point #5), and eventually a manned mission to Mars. We need to continue where Skylab left off, providing the technology to insure that near-earth space remains permanently peaceful, and incidentally, to equal and eventually (hopefully) surpass the USSR in our ability to live and work in a weightless environment.

Space Applications

In the area of Space Applications, at this point I would give a lower priority relative to Space Shuttle Applications and to Science. To some of you this may seem startling, based on my statements of previous years. However, Space Applications have always been the easiest programs to sell because it is so obvious to the public that they can be justified. Space Applications do have the greatest near-term returns and therefore never should have a low priority, but at this date, perhaps it has been pursued at the expense of the Science Program and I think has been doing rather nicely in recent budget cycles. Programs such as Landsat, NOSS, Stereosat, and a Broadcast Satellite all make good sense and should be pursued. However, it should always be remembered that today's Science is tomorrow's Application and NASA must quickly turn over new Application Satellites to the appropriate Federal Agencies. NASA must continue to be future-oriented and when a choice arises as to whether NASA should become an operating agent or should pursue new Science or new Applications, the choice should be an easy one. Only when another Federal Agency has not been able to pick up an Application Satellite program should NASA continue to perform the operational function. The important role of NASA must be to focus on the future - in fact, it may be the one Federal Agency which has this role preeminently in its charter.

Future-Oriented Programs

In this latter regard, I think we should be courageous enough to support distant future-oriented programs -- at least, at modest levels of funding. Although I agree with Dick Atkinson that the Senator from Wisconsin has been a long-time supporter of Science and, in fact, even of the Space Program when the Program focused on the short term, I think the Senator does a disservice to the Nation in being over critical of programs with only long-term payoffs. In one particular case, "the Search for Extra-Terrestial Intelligence" (SETI), I think it most unfortunate that funds were curtailed. Even though the probability of success for such a search may be small and even though the funding level proposed is very preliminary to a full-blown Search, the impact of a contact with other intelligent beings in our Galaxy is beyond calculation or even comprehension. Who could put a price tag, for example, on the value of "The Renaissance"? I am sure that any extra-terrestial contact would have at least as great an impact as did the contacts with the Moslem and former Greek civilizations in the mid-Fifteenth Century. The problem seems to be that we are afraid to put small amounts of money into projects that have a chance for enormous payoffs. Strangely, however, we seem to spend large sums of money on programs which have very small chance of large negative consequences, (e.g., nuclear accidents), and probably justifiably so. However, by emphasizing "accidents", instead of potential "renaissances", we reverse the words of the song and "accentuate the negative and eliminate the positive". I believe this is the wrong direction for our country to take.

Feasibility of Large High-Challenge Programs

One of the questions asked by this Subcommittee and apparently addressed by the Presidential Task Force relates to the feasibility of large new technical programs. I do not at all agree that large high technology programs are "premature and infeasible". Many programs are ready to be started now and probably *should* be started if it weren't for the serious economic difficulties in which our country finds itself. There is no question at all in my mind that we must begin to put serious restrictions on government spending and it would seem inconsistent in the public mind to be starting large new space programs at a time when we are in such dire straits. This is the only reason for not starting large new programs - not the fact that such programs are "premature and infeasible". I think that when our economic situation eases, we ought to ask ourselves what kinds of Federal spending contribute substantially to inflation and what other kinds do not. I am convinced that if this question were asked of all the programs in the Federal Government, the Space Programs would rank high in terms of avoiding inflationary impact. In fact, most NASA programs would be found to be *de*flationary, whereas most other government programs would have to be labelled *in*flationary. This, of course, is hard to prove, and even though some of the studies seem to show this result as an obvious effect of NASA expenditures, I think much more study needs to be done to substantiate those earlier studies. In any case, as soon as our economic difficulties begin to ease, I think we should immediately start whatever large programs make sense at this time. Some examples that come to mind are the Space Platform, an

Unmanned Mission to Mars, programs to Orbit Saturn, to Orbit the Moon in a north-south direction, and many others.

Institutional Base

Another question that is often asked has to do with NASA's Institutional Base, both in Personnel and in Technical Support. In the latter case, Technical Support has been eroded over the years and, I must confess, some of it during my own term as Administrator because of the constant pressure to "trim the fat" in NASA's programs. We've got to find ways of stopping that erosion; otherwise, it will not be possible to mount large new programs in the future. The funding for the technical base has always been small and need not be a large proportion of the total budget, but longer-term programs are always somehow easier to cut than immediate ones. I think the technical base would survive very nicely if some of the pressure to reduce the overall NASA budget were relieved. This is not a simple problem but I think it is up to the leadership in NASA, as well as Congress and OMB, to make special effort to preserve this base.

Even as a more general consideration, I submit that we have been pennywise and pound-foolish when we cut easy programs that do not impact the near term but leave current programs untouched. In the long term, NASA's programs not only are going to contribute to a healthy national future, but even in the near term, they are anti-inflationary and should be pursued if a choice becomes necessary between NASA and other Federal programs.

With regard to NASA's Civil Service complement, I think it is almost criminal the way we have, year after year, not only trimmed the work force but also threatened to close down Centers. If we feel that the work force needs to be smaller, we ought to make a one-time only cut to the size that we think it should be and then leave it alone. It seems to be almost impossible to get an agreement to do that from either the Executive or the Legislative Branches and so, year after year, we trim additional manpower. This not only causes young people to avoid joining the program, but also impacts all the way back to universities, and in general, gives a bad feeling, both within and outside of NASA, about the future of the Space Program.

With regard to closing a Center, I think that would be a foolish exercise. Obviously you need all three Centers - Marshall, Johnson and Kennedy - to continue the Manned Space Program. You probably could do all of the Science and Applications in one Center by combining the Jet Propulsion Laboratory with the Goddard Space Flight Center, but I think these programs are so important that it would be demoralizing to the people involved in the two Centers to eliminate either one of these organizations. The Aeronautics Centers are outside the scope of this presentation, but I feel they also are adequate for the Aeronautics Program. I suppose what could be done, if there were pressures to do so, would be to reexamine NSTL (National Space Technology Laboratories) as to whether it should be reassigned to either the Johnson Space Center or the Marshall Space Flight Center, but I think that would then cause at least as many problems as it did when we separated it in the first place. The relationship seems to work well and I don't see any reason to disturb it. NSTL has a very specialized function, that is, testing of large engines, and as long as we are involved with the Manned Space Program, it needs to be maintained geographically separate from the Marshall Space Flight Center. I think the organizational arrangement is really a minor aspect of the problem.

Summary

In summary, I believe:

(1) NASA should continue to be future-oriented and should emphasize those programs that may have a positive impact on our Nation's future.

(2) We should not be afraid to undertake large high-challenge technical programs when they are warranted. I would only hesitate in this particular Fiscal Year because of our current national economic distress, but in normal years I would proceed whenever it made sense, and I hope that is very soon.

(3) We should not be afraid to support, at a low-funding level, programs that relate to the distant future but which have the potential for very large social impacts. Both L5 and SETI are examples of such programs.

(4) NASA, with the help of Congress, must be extremely cautious about the constant erosion of its technical base. Much of this erosion is a result of purely political considerations, and in the past, this technical base has been cut too deeply and too often. With the help of Congress and with the Space Shuttle nearing completion, I think NASA must move forward into the 80's with a positive approach to its future and with sound programs in Science, Applications, and in Human Occupation of Space in a way which will make the country again proud of NASA and NASA's accomplishments, as well as proud of itself for having encouraged NASA to do so.

QUESTIONS FOR DR. FLETCHER

Question 1. New programs and goals are being dictated by year-to-year budget pressures and funding problems with the Space Shuttle.

(a) What can be done to overcome the resultant erosion of our technology base and capabilities?

(b) Is NASA proposing enough new programs to justify maintaining a healthy institutional base?

Answer 1(a). This question was answered in my testimony of July 24, 1980, but to reiterate: To prevent erosion of NASA's technology base requires continued effort by OMB, the President, and Congress to focus on the technology base to insure the continuity and adequacy of the funding.

1(b) This also is partially answered in my testimony. Clearly, NASA has not been proposing enough new programs, particularly in the planetary and orbital science programs. These are not only inadequate to justify the healthy institutional base, but actually are not adequate to maintain the industrial base as well. Many contractors are on the verge of pulling back their efforts in science areas.

Question 2. One tenet of the Administration's space policy states: it is neither feasible nor necessary at this time to commit the United States to a high-challenge space engineering initiative comparable to Apollo.

(a) Do you agree with this statement?

(b) What do you consider to be appropriate long-term goals for NASA to undertake after completion of the Space Shuttle.

Answer. 2(a). As I indicated in my testimony, I do not agree with the statement at all. It is both feasible and, in my opinion, necessary in the next year or two to commit the United States to a "high-challenge space engineering initiative."

2(b) Some appropriate long-term goals were indicated in my testimony, but I would say the most urgent is to begin the development of a manned space platform. Almost as urgent in the unmanned area is to begin the development of a "mobile lander" on Mars. Another program which is worth considering—even at this early date—is a Space Power System (SPS).

Question 3. Should NASA's charter be broadened to include a greater role in dealing with other national needs such as energy?

Answer. As indicated in my testimony, I am ambivalent about changing NASA's Charter. There are strong reasons to do so from the point of view of fulfilling our nation's energy needs, but I would hate to see this done at the expense of the Space Program.

Question 4. Should NASA perform research and development only, while avoiding operational responsibilities?

Answer. I also indicated an answer to this question in my testimony, but to reiterate, I would ask NASA to continue "operational responsibilities" only when no other Federal Agency has agreed to assume these responsibilities.

Question 5. Is NASA appropriately staffed and does it have the appropriate number of field centers for its projected role?

Answer. As indicated in my testimony, it does not make sense to reduce the number of field centers now in existence, and although NASA is almost adequately staffed, it does not make sense to continually peck away at the total complement in NASA. This only causes morale problems and difficulty in recruiting young scientists and engineers.

Question 6. What concerns, if any, are raised by the President's directive providing new guidance directing technology transfer, data sharing, and hardware sharing between the civil and military programs?

Answer. As indicated in my testimony, I do not become concerned about the Presidents Directive regarding Technology Transfer, Data Sharing and Hardware Sharing with military programs.

Question 7. Does the National Aeronautics and Space Act of 1958 provide an adequate charter for civil space activities?

Is there a need to reaffirm the Nations leadership in exploring and developing the space environment for the benefit of mankind?

Answer. As I indicated in my testimony, I very much believe there is a need to reaffirm the nations leadership in space. I think the President, himself, has to do this and, at the same time, set the nations sights on some longer term high-challenging goal and stick to it for at least the remainder of his Administration.

Question 8. While NASA's eroded budget is barely holding its own against inflation, the DOD's space budget is accelerating.

(a) Is the Nation pursuing a proper balance between the civilian and military aspects of the nation's space program?

Answer. I believe the balance is approximately right between the civilian and military aspects of the Nation's Space Program since, in my judgment, the military has a most urgent need for growth. However, I do not think this should be made at the expense of NASA by overly constraining its funding. NASA's programs should be considered on a case by case basis.

Question 9. Is there a need to establish and articulate long-term policy goals for the civilian space effort?

Answer. The answer to 9 is "Yes."

Question 10. Many have proposed that the United States should commit to development of a Global Resource Information System. Establishing of a national operational civil remote sensing system is a first step.

(a) Should the United States commit to a Global Resource Information System?

(b) What benefit would be derived from such an undertaking?

Answers. 10(a) The answer to 10(a) is also "Yes."

10(b) It is difficult to describe at this date all the benefits that would be derived from a "Global Resource Information System" but it is clear that the U.S. and the rest of the world can better deal with many global problems if such a System were accessible to the major industrial nations. Such problems as the global ozone layer, the carbon dioxide problem, global air and water pollution, as well as global mineral and energy resources would all benefit by having a "Global Resource Information System."

Question 11. Should we support distant long-term programs such as the Search for Extra-Terrestrial Intelligence and Space Colonization?

Answer. The answer to this question is "Yes indeed!" At the present time these programs do not need extensive support because they are still in the study phase. I think it is extremely short-sighted to cut out programs of this sort which at most could spend a million or two a year when the results of the successful program could not even be calculated in terms of GNP or any other economic measure.

Question 12. In March the Congress received a revised NASA fiscal year 1981 budget request which reduced the 1981 budget but will result in an increased cost to the taxpayers to accomplish the same programs.

(a) What advice do you have on minimizing the impact of such politically motivated decisions?

(b) Would NASA have been better off to terminate an on-going development program?

Answers. 12(a) My advice to anyone engaged in this kind of an exercise is: "Don't do it!" NASA has been pushed and pulled too long by the political winds of the moment.

12(b) The answer to this is also "No!" It is best to leave NASA alone in this kind of a political exercise. It is just this kind of budget constraining exercise that is a major part of NASA's current problems. Most of these cuts in past years have been politically motivated. In my judgment, there is absolutely no reason to do this to an Agency like NASA when there are vast amounts of money spent in other agencies of the Government which have very little benefit.

Question 13. Are we adequately supporting civil space-laser applications? Should NASA be more involved in this activity?

Answer. I can't answer this question since I haven't been closely associated with "civilian space laser applications."

Question 14. We are approaching the fifth anniversary since an American flight crew last traveled in space and are approaching more than four years during which no imaging data will be returned from other planets via United States spacecraft.

(a) Should we be concerned? What does this say about our Nation's commitment to maintain a leadership position in space?

Answer. I believe that our Nation should be concerned because we are in danger of losing the expertise gained on Apollo. In fact, during the Apollo days, we did not allow the gap to be more than six months or so because we were afraid of losing the intuitive sense of reliability on these manned space flights. It is difficult to say very much about the "Nation's commitment to maintain a leadership position" since for six years I was in a position to influence the

Space Program and it was during my administration that two years of this gap were allowed to happen. I think this is more the lack of good planning by our Nation, rather than a lack of leadership, but, of course, I address this from a biased point of view.

Question 15. Can we really expect a significant expansion of public interest and a reasonable return on our national investment without a challenging space engineering initiative?

(a) How can such a program be made appealing?

(b) What should the criteria be for identifying the program?

Answer. 15(a) I believe I answered this adequately in my testimony of July 24. I think that the whole program can be made more appealing to the public but, in fact, "a challenging space engineering initiative" would make it more so.

15(b) I also indicated in my testimony some of the elements of new programs that we might initiate which include: (1) Men and women in space; (2) Further demonstrations of weightlessness; (3) Extensive TV coverage; and, (4) A worthy but almost unattainable goal.

Question 16. What lessons were learned from the post Apollo era that should now be applied to deal with the post Shuttle era?

Answer. I gave a partial answer to this question in my testimony. To reiterate, some lessons that were learned are:

(1) "Design to cost" is feasible on a manned space program but only under the conditions of in-depth technical monitoring.

(2) We must not neglect in such large scale programs the principal high technology risk items which, in the case of the shuttle, were two: Space Shuttle Main Engine (SSME) and the Thermal Protection System (TPS).

(3) We must not allow politicians to manipulate funding profiles for large programs such as Apollo and Space Shuttle.

Question 17. Your tenure as Administrator of NASA was perhaps the most innovative in the post-Apollo era.

(a) How can the space policy of our Nation be shaped to restore a more positive environment for innovation and accomplishment?

Answer. I think the Space Policy of our Nation can indeed "restore a more positive environment for innovation and accomplishment." NASA is the only Government Agency whose mission is future-oriented. This, plus asking NASA to help with other Federally-sponsored high technology programs (such as the SPS) would give to the public the feeling that there are some things of an urgent nature that the Federal Government can do well.

Question 18. What is your perspective of how the youth in the United States view the space program?

Do you sense that there is support for new space initiatives among college students?

Are there an increasing number of engineering students enrolling in the aerospace curriculum, or do they still tend to shy away from what may be an uncertain profession?

Answer. There is no question in my mind but that the youth of the nation view the Space Program with a great deal of respect and admiration. There is a more than ample support for new space initiatives among college students and, in fact, according to surveys that NASA made during my term as Administrator, it was indicated that the younger the person, the more positive they were to the Space Program, and the more educated the person, the more positive they were to the Space Program. As to the number of engineering students enrolled in aerospace curriculum, this has tended to drop off even though the interest is very high. Many of our young people in and out of the universities would like to become involved, but with so many ups and downs in the Program, they do not wish to take the risk. It is most urgent that this impression on the part of the young people be corrected by a positive, sustained and forward-looking Space Program.

Question 19. In your opinion, should the President be doing more to increase public support for space programs?

If so, what methods would you like to see him employ to accomplish this end?

Answer. This was also answered in my testimony and again in response to Question Number 7.

Question 20. Do you see a need for additional Presidential space directives for either civilian or military programs, or are the 1978 directives sufficient for spelling out U.S. goals and plans for space?

Answer. I do indeed see a need for additional Presidential Space Directives. A positive statement backed up by the initiation of a major new program and followed by a "sincere" statement committing the Presidency to this program would go a long way toward improving the motivation not only of NASA and the aerospace industry, but of our entire nation as well.

Mr. FUQUA. Thank you very much, Jim, for a very interesting and enlightening statement.

I might say that I appreciate very much the candid manner in which you addressed some of the issues.

Dr. FLETCHER. It is much easier these days, Mr. Chairman.

Mr. FUQUA. It is a lot different than some of your other statements that you have made, but they are still consistent with what I knew you felt, even in those days.

You mentioned that we should not be afraid to undertake large, high challenge technical programs.

Dr. FLETCHER. Yes.

Mr. FUQUA. We have asked several witnesses similar type questions. This morning I asked Dr. Press what he meant by that.

It seems as though it is never a good time to undertake those programs. He defined what the administration's policy was. It was something of $25 billion to $100 billion program or a large engineering effort.

What would you describe as a high challenge technical program? Would you want to fix a cost?

Dr. FLETCHER. Let me mention several. I think, for example, that we ought to think in the science area seriously about going back to Mars, and instead of landing in two places, let's land in a place where we can move around a little bit. The Russians at least had a lunar probe vehicle that was a robot. It worked well. It seems if the Russians can do it, we ought to be able to do it. That would be a $2 billion program in today's dollars, even though Viking was done for $1 billion. But things have changed. That should be pursued.

Mr. FUQUA. And not have it returned?

Dr. FLETCHER. A one-way mission to Mars. There would be robots only, but exploring the surface and not just those two spots that we were able to land on. That is in the science area.

Now, in the post-Shuttle area, I think we should start immediately building a simple space station. It really makes me shudder, Mr. Chairman, a little bit whenever I read about the Russians continuing in space and saying they have a permanent space station. They have had people survive much longer than any of our Americans in space.

We are going to have to go back to them to learn about the biological behavior of men in long-duration space flights. We therefore ought to pursue a space platform.

Mr. FUQUA. You indicated this could be done in a rather inexpensive fashion.

Dr. FLETCHER. Yes. My personal opinion, and I have to keep changing it to today's dollars, but my personal opinion is it could have been done when I was here for something under $2 billion. It has probably gone up since then. I would have aimed at $1 billion. That seems like an awfully small amount.

That is the kind of thing I am talking about, a $2 billion program to establish a simple, long-duration, permanent space platform.

I would add on to that as the need arose. It would be the beginning of a home for people to live in. That is not an expensive program. It is a high-challenge program.

Mr. FUQUA. What you are speaking of is we do not have to go into a $50 billion to $75 billion program in order to accomplish this in the initial stages.

Dr. FLETCHER. No, we would not.

There is the space solar power satellite, for instance. Now, I would hesitate actually going ahead full speed on that. That would be a $20 billion to $30 billion program. I think we need to pin down some of the variables a little better, especially the cost and the weight of the photovoltaic cells.

However, I think we should get ready for that program by building the appropriate launch vehicles. I think as soon as the Shuttle is flying and is operational, we should think about what we used to call a "heavy lift launch vehicle." This would be required.

I think we should make the first move in that kind of a program, even though it is very expensive.

Mr. FUQUA. The House has passed a bill that was reported out of this subcommittee and the committee for $25 million as a program for a follow-on study to answer some of the questions that have not been answered yet. It would be only in text books that they are answered, and many are theoretical. This is so that we could prepare for some later decision should the Congress or the administration, whatever the administration may be at that time, make that choice.

Unfortunately it has not moved in the Senate. We are still hopeful. I agree with you that it would be foolish to go for the full-scale version at this time. I think there are many intermediate steps that we could take in an orderly fashion so that we can answer some of those questions.

Dr. FLETCHER. I completely agree with you. That was a good bill. We never could have gone to the Moon if we had not done the preparatory work on the engines and the launch vehicles beforehand.

Mr. FUQUA. How do you think—and I know that you mentioned this earlier—but how could we go about both as a Congress, NASA, and the administration increasing the public support for the space program?

Personally, I think there is a tremendous amount of public support for the space program. It has been proven over and over again, even in votes on the floor of the House and in the Senate.

I think Congress generally reflects the mood of the American people, whether they like it or not. There has been, I think, generally overwhelming support for a reasonable space program. Do you see that as eroding or how do we better involve people as you mentioned? How do we involve the public in a better understanding of the space programs?

Dr. FLETCHER. Now, Mr. Chairman, your first statement is correct. I think there is a large public support for the space program. I would guess at least one-third of the country, if not over half, are very disappointed because we did not pursue a more vigorous space program.

I am disappointed also. I had hoped the Shuttle would be flying by now and we could get on with the next phase. So I do not know whether we need greater public support.

I do think we need greater public involvement in some aspects of the program. The public really does not know what a Landsat is. They do not realize in many cases how useful the communications satellites are and the weather satellites that they see every day.

Somehow we have got to make them see the value of each program as it comes along. This, I guess, is by involving them. That is the best way I can describe it.

Let them participate in the decisionmaking. Make it more visible as to what you are doing. Do not confine it to the scientific community. Let them know what you are actually learning. Let them know in a pictorial form so they can see it.

They are paying for it. They as well as the scientists, ought to get some of the pleasure out of it. I am not sure how much education is required. I think it is involvement more than education.

Mr. **Fuqua**. I think a lot of it is taken for granted. Now, when the weather comes on the 6 p.m. news, the weather forecaster says, "We will now take a look at our weather satellite picture." You take it for granted that it is something that is supposed to be there, and you never stop and think how it got there or think about what went into that information that the people get every day. That is just one example.

The other is probably in satellite communications where we expect to see or did expect to see the Moscow Olympics, but we do see events happen every day around the world on the 6 o'clock news.

Not too many years ago that was totally impossible. I think we do in many cases fail to realize or appreciate that. Landsat has tremendous application, not only to this country, but all over the world. We should fully appreciate the efforts that went into that and how we can improve it and how it can be used as a tool to improve our life style and better communicate with people around the world.

Dr. **Fletcher**. I completely agree.

Mr. **Fuqua**. Mr. Brown.

Mr. **Brown**. Thank you, Mr. Chairman.

Dr. Fletcher, I commend you for your statement. It is an excellent statement and one which I think can almost serve as a basis for our future space program.

The problem we are grappling with here or trying to grapple with is what is it we need to do to provide a strong base of support for the future of the space program. We are looking at a number of problem areas.

We are discussing whether or not, by restating our goals or laying out a 20-year programs or something of that sort, we could do something to provide a firmer base of support for the space program. Yet I am not sure this necessarily would accomplish what we want to do.

For example, when we landed a man on the Moon, we did not necessarily have to rewrite the law to do that. That was done by exciting statements in a statement from the President of the United States. In other words, it was by creating a sense in the American people that this was an important goal and mobilizing the resources and the public support to do it. So I am wondering whether the answer is an improved charter for NASA or improved leadership, whether it comes from the President or the Congress, in terms of presenting an exciting and challenging picture of what we can do here to the American people to get their support.

Could you comment on that question? Basically, how important would it be to rewrite the charter with a more detailed spelling out of some of the exciting things that you have listed in your statement?

Dr. **Fletcher.** Now, Mr. Brown, I think it is important to write this down and get the Congress to agree on what needs to be done. I would even, at this point, think it would help to write down the goals in somewhat more detail than appears in the 1958 charter.

However, I think even more important is to encourage the President to speak up and say this is what we are going to do. I can understand why Presidents do not do that, irrespective of party. I am speaking in this particular case as a nonpartisan.

It is difficult for Presidents to get up and say this is what we are going to do. Next year the winds may shift and we get a different kind of political wind.

I was just reading today a statement by former Secretary Blumenthal about the problem of inflation. The President ought to get up and say this is our No. 1 problem. He said we are schizophrenic. "This schizophrenia which comes out of the American system to some extent comes out of the basic constitution of the Democratic Party. It has made it difficult to develop a single, clearly defined line. It has made it difficult for the President to stand up and say, 'My economic philosophy is the No. 1 and that is what I am going ot stick to. That means we all have to tighten our belt and really carry that through.' We must clearly give the impression this goal is above everything else."

This has always been confused by "yes, but." I think that is our problem with the space program, as well. The President has to speak up as well as the Congress.

Mr. **Brown.** I think that this committee will try to carry out its part of the responsibility. I cannot speak for the President.

Quite obviously, some of our commitments have been made in response to exterior or external challenges. Our commitment to land a man on the Moon was based on a perceived threat of loss of our superiority in space as a result of Sputnik.

Now, conceivably, the way to keep our space program healthy would be to have a secret agreement with the Russians that they make some startling breakthrough which challenges us and then we challenge them to overcome it. We do this in defense. There would be a large commitment of resources.

Dr. **Fletcher.** I think we have a threat very similar; in fact, a much more serious threat. It is beginning to dawn on us, but it is there, nevertheless. That is the threat of running out of energy to support the growth in the economy, and more important, the well-being of us all.

I do not think we are going to run out of oil and coal as soon as people think. This carbon dioxide problem might very well be a serious one. I personally believe we should pursue it as hard as we can to find out whether it is a possible difficulty in terms of causing the warming of our planet.

Whatever the case, I think spending $25 billion or maybe $50 billion, as necessary, to at least bring about a way to get around that problem that does not have the difficulties of nuclear power is something we should look at. That undoubtedly has some environmental problems, but they are surely not as severe as nuclear.

You could get up and say all right, this is what we are going to do. It may not be cost effective; it may not be as cheap as coal; but we are going to do it anyway. If it turns out to be cheap enough, we will do a lot of it. That is the kind of thing that needs to be done.

It is a challenge. It is much more serious than the threat of Sputnik. It is a challenge not only to us, but to our children and grandchildren. That could be an easy, straightforward goal.

It is a threat. We were talking about going to war over the lack of oil in the Persian Gulf. That is a more serious threat, it seems to me, than anything we have had in earlier times in the space program. So that would be a possible one to pursue.

I think it ought to be pursued in an orderly fashion. Nevertheless, stated as a goal, we are going to do it, if we do it in the next 20 years, that would be a very straightforward thing for the President and the Congress to do.

Mr. **Brown.** Let me pursue with you for just a moment the very exciting picture that you gave of enhanced public involvement in the space program. I am sure you are aware that this committee has long supported the idea of first putting more emphasis on science education, in general, and second, utilizing the spinoffs from space as an aspect of our total science education or science literature type of program.

On that basis, we have supported both things like NASA's technology utilization program and the development of initiatives, such as visitor centers at the various locations where we have them.

I am particularly interested in whether we can follow your suggestion and the best way to do it, or even greater involvement. Can we, for example, do more with facilities like we have at Cape Kennedy and at Goddard, where we have visitor centers and public education programs?

Can we take something like the Landsat center, which translates Landsat imagery into useful products, and create a laboratory there or create a center for involving people in some exciting way? Can we have more of these, say, centers of population where people can actually have access more conveniently and in other ways perhaps to jazz this thing up a little bit so that these products become a vital part of our television programing, of our school curriculum, and other ways?

Dr. **Fletcher.** I think there are definitely a lot of things we can do. NASA has always been under pressure to keep its public information program low. I always resented that pressure.

By the way, Congress usually helped us out and put some of the funds back. That is where we kept being cut continually. It seemed as though we are trying to sell our program.

I do not think that is what I was getting at in my earlier remarks. I think we need the public to be involved. They need to share in the excitement. They were very excited about the Apollo program when that landing took place on the Moon or the Gemini and the Mercury projects.

Surely we can build up our visitor center at the Cape and at Huntsville. They have a nice visitor center there, and they have the Goddard Center. Also there is one at Sioux Falls.

We also need to develop the appropriate programs. We do not have to develop them ourselves, but to develop the materials so that commercial people can develop the programs. These are all part of what I mean by greater public involvement. I think we ought to invite more of them to come and to see what seemed to be routine space shots or satellite launchings and things of that sort.

That whole collection of public education items is, I think, crucial to any space program. I think 1 percent of NASA's budget, if it were spent on that, would make the whole country feel better about itself. Right now we have a low opinion of ourselves. I think that is bad.

Ten or fifteen years ago, we had a high opinion of ourselves. Part of that was the space program.

Mr. **Brown**. I have often given thanks to Walter Cronkite for his interest in the space program. He has helped to do a great deal in creating a sense of public excitement about the program, and the space program in general.

I agree with you. We have neglected many opportunities to do this, particularly around some of the things you have mentioned, such as the L-5 program or the search for extraterrestrial life. I think these can be tremendously exciting to a large number of people, and they are not too expensive.

We could use them as educational tools, as well as practical technology development programs.

Dr. **Fletcher**. You mentioned one of my favorite persons, Walter Cronkite. It might be interesting some day, Mr. Chairman, if you asked Mr. Cronkite when he retires to give his real views of the space prorgam. He is restricted, the same way I was when I was at NASA, by his producers. He has a very positive notion about the space program.

Lowell Thomas is another oldtimer, but he is very enthusiastic about the space program. Nearly everybody I talk to in the media are disappointed that we have not pushed more vigorously in the space program.

Mr. **Brown**. Thank you very much.

Dr. **Fletcher**. Thank you.

Mr. **Fuqua**. Thank you.

Have you any questions?

Mr. **Winn**. No, but I want to apologize for not being here earlier.

Mr. **Fuqua**. He does not have the staff he used to have to answer those questions.

But I want to thank you very much for your testimony and your answering of the questions and your observations. I think it is most helpful to us so that we can try to get a better understanding of where we should be going.

You certainly made some constructive, positive contributions. We want to thank you again very much for taking your time and coming here today to be with us.

Dr. FLETCHER. Thank you, Mr. Chairman.

Mr. FUQUA. That concludes the hearing today. The subcommittee will resume next Tuesday at 10 a.m., in room 2325, where we will take up the civil remote sensing system.

The subcommittee is adjourned.

[Whereupon, at 3:10 p.m., the subcommittee adjourned.]

APPENDIX

1284 Graff Court, Apt. 1B
Annapolis, Maryland 21403
July 18, 1980

The Honorable Don Fuqua
Chairman, Committee on Science and Technology
U.S. House of Representatives
2321 Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Chairman,

Enclosed is the District Five Energy Committee of B'nai B'rith testimony for the hearings of July 1980 in the United States House of Representatives on Civilian Space Policy and Future Space Opportunities to be published in the record of those hearings.

Thank you for the opportunity of presenting this testimony and placing it on public record.

Sincerely,

Bruce Friedman

Dr. Bruce Friedman, Chairman
District Five Energy Committee of
B'nai B'rith

Abstract of the Testimony for the Hearings of July 1980
in the United States House of Representatives on
Civilian Space Policy and Future Space Opportunities

Dr. Bruce Friedman, Chairman
District Five Energy Committee of B'nai B'rith

B'nai B'rith has developed criteria which it believes that any civilian space policy must meet. Any new civilian space policy must be far more aggressive and ambitious than is now expressed by the current space activities of the United States. The concept of space industrialization should be central to any new civilian space policy. The policy should also include strong components supporting scientific research and exploration, such as the search for extra-terrestrial life. B'nai B'rith has determined that both of the space policy bills under consideration at these hearings, that of Representative Brown and that of Representative Dornan, are acceptable to B'nai B'rith and that both bills could be improved by incorporating the recommendations and suggestions of this testimony.

Testimony for the Hearings of July 1980 in the United States House of Representatives on Civilian Space Policy and Future Space Opportunities

Dr. Bruce Friedman, Chairman
District Five Energy Committee of B'nai B'rith

The District Five Energy Committee of B'nai B'rith sincerely appreciates this opportunity to present its views concerning civilian space policy and future space opportunities. District Five of B'nai B'rith comprises the Washington, D. C. area, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida.

The necessity for a discussion of civilian space policy and future space opportunities can be determined by considering inputs from a number of points of view. One analysis to be considered is that from the historical point of view. A second possibility is to examine the formulation of space policy in terms of the needs and wants of the individual American and of American society as a whole. A third analysis is that from the perspective of the external challenges facing the United States of America. Of course, these approaches to the formulation of a coherent national space policy are interwoven with each other and thus the space policy that would finally be chosen would result from a synthesis of these three routes.

The historical approach commences with the first appearance of life on this planet. No one can say for sure how life began. One possibility starts with the conjecture that the conditions on the primeval earth of several billion years ago were such that simple carbon compounds were formed. The processes involved used energy from volcanic activity, thunderstorms, meteorite falls, solar ultraviolet radiation and other energy sources to combine, among other ecules, the nitrogen, carbon monoxide, methane, sulfur dioxide, hydrogen, and water vapor found in the atmosphere into such compounds as hydrogen cyanide, formic acid, acetic acid, glycine, and dicyanimide. These latter compounds would further interact with additional energy inputs to form more complex compounds such as amino acids, pyrimidines, purines, and fatty acids. Numerous experimental simulations have confirmed that these reactions could have occurred.(1)

It is also possible that the formation of the first organic compounds may have begun in space even before the earth existed. Cosmic dust particles could have provided the catalytic surfaces for these syntheses.(2) This situation has helped give rise to the field of interstellar organic chemistry.(3) (The Weizmann Institute in Israel has tentative plans to perform an experiment on a flight of the space shuttle in order to study how amino acids connect with each other under free-fall conditions.)

This first step in the creation of life is termed chemical evolution. The next step is called protobiont. This step occurs when the organic compounds present from the first step are organized into a cellular form having some biological characteristics with the remaining characteristics being in a process of evolution. A. I. Oparin and his associates have developed a model of a protocell which protocell comprises mixtures of colloidal particles. S. Fox proposed a model based on amino acid polymers called proteinoids. J. D. Barnal proposed that an important mechanism in the formation of polymers from small organic molecules arises from the adsorption, activation, and polymerization of these molecules upon clays. C. E. Folsome proposed as a result of his observations of spark reactions that protocells were generated from polymeric material within the early small bodies of water along with small organic molecules.(1)

Any space policy statement enacted by Congress should be supportive of research in the biological sciences with a particular emphasis on studying the origins of life on this planet and throughout the universe. Space studies make available to researchers a much broader range of source materials. For example, data from space-based radio telescopes could clarify the role of interstellar space itself as compared to reactions on the surface of and within the atmosphere of the earth in the formation of the first molecules.

Radio telescopes located in space itself can be made several orders of magnitude larger while maintaining their precision of construction than is possible here on this planet because of the free-fall environment. The larger size allows the telescope to reach out further into the universe and vastly increases the sensitivity of this device to radio emissions from organic molecules in interstellar space. These capabilities would allow for a more accurate determination of the distribution of the various kinds of organic molecules throughout the universe. This sort of data could aid in choosing among the various hypothesesas to the origin of life and aid in the formulation of new hypotheses which might be more intellectually satisfying.

There are a number of options, all of which may eventually be utilized, as to where to put radio telescopes in the extra-terrestrial environment and how these telescopes could be used together or singly. One possible location is in the geosynchronous orbit. Another is at one of the Lagrangian libration points in the earth-moon system. A telesope situated at the libration point wherein it has the moon between it and the earth could be shielded in this manner from the radio wave radiations emanating from the earth. It might be desirable to have a telescope on the surface of the moon itself. Since there will eventually be a variety of activities on the moon, the support of a lunar ervatory including both optical and radio telescopes might be more convenient to maintain than at some points in space itself. In order to vastly increase the sensitivity of radio astronomical techniques, telescopes that are separated by hundred of millions of miles could be operated together in an interferometric mode. This interferometric possibility has been broached by scientists of the Soviet Union. Their proposal considered one giant telescope in the orbit of Saturn with the other one in an orbit about the earth. On a Salyut 6 mission the Soviets operated a small radio telescope on the spacecraft in conjunction with a radio telescope on the ground.

Experiments can be performed at an early stage of the space shuttle era with the European Spacelab to increase the understanding of the chemical evolution and protobiont steps of the creation of life. By performing experiments in the free-fall environment of space, it should be possible to more clearly delineate the roles of factors such as surface tension, convection, and gravity on the beginnings of life. For example, with only surface tension forces present in a liquid medium it might be possible to determine how polymerization occurs and at what rates as compared to when convection also occurs in this medium.

The objective that investigations into the origin of life are part of a coherent national plan to explore and to utilize the extra-terrestrial environment apparently seems to fulfil no immediate practical purpose. However, such a goal helps to set a certain philosophical tone. This tone can be described as the national space policy providing simultaneously for an expansion of mankind and its instrumentalities while providing for an improved understanding as to how life on this planet and particularly humanity arrived at this point in time at which such an expansion is possible. Increased awareness and understanding of the self, whether self is applied to the individual or to

.iety as a whole, tends to increase confidence in that self and gives greater surety that the choices being made to assure the continuance and betterment of life are reasonable and healthy choices. Considering the present state of mind of American society, anything that is morally and ethically correct that can aid in giving the nation a better sense of direction is certainly to be desired. Many of the diverse groups of which the United States of America is composed are seeking a better understanding of their origins so as to help in instilling within themselves a stronger sense of purpose and of their destiny. Consequently, a better understanding of the origins of terrestrial life should give all of humanity a firmer sense of purpose and of its destiny. Because the United States has taken a leadership position in the world community it is important that it should phrase its goals in any formulation of national space policy in terms of all of humanity wherever this is possible and practical.

Radio telescopes are only one tool that space researchers can use in the search for the origins of life. Telescopes utilizing the radio wave portion of the electromagnetic spectrum have a tendency to come to mind first nowadays because of the major discoveries in radio astronomy that have occurred since the end of World War II. It is only a few years ago that alcohol of the type found in whiskey and wine was discovered in interstellar space. Presumably this alcohol was created by some means other than the fermentation process which results in those liquids which give delight to so many people.

A formulation of space policy should list a number of instruments to be used in the search for the beginnings of life. Optical telescopes can be used in the same locations and with a variety of types and modes of operation in the case of radio telescopes. Work has already commenced on the first large optical telescope to be placed in earth orbit by the space shuttle a few years from now. Spectroscopic observations of celestial bodies with this telescope can be used to help determine their composition. Unmanned probes with advanced onboard computers should be sent out in the coming decade to nearby planets such as Mars and Venus and such moons as they have and to the asteroids. These probes would be equipped to land and to make sophisticated physical, chemical, and biological investigations. The Viking probes of Mars have already commenced this process with very rewarding results. Some of the probes could be equipped to procure actual samples of material from the body under study and to return such samples to the earth for further examination. Probes could also be sent to investigate and sample the nuclei of comets far from the sun. Such cometary material could be among the oldest in the solar system.

Part of the search for the origins of life is the determination as to whether or not life now exists beyond the earth which is of extra-terrestrial origin. If such life should have similarities to terrestrial life it would be a significant clue as to the origins of all life, both terrestrial and non-terrestrial. One of the objectives of the Viking mission was to ascertain if Mars has or has had life on it similar to that on earth.

Certainly a space policy statement should have as one of its objectives the search for extra-terrestrial life and beyond that it should have as one of its primary goals the search for intelligent extra-terrestrial life.(4) Depending upon the circumstances under which the initial discovery of intelligent extra-terrestrial life were made, the impact of such a discovery would have profound consequences for both the individual and society. The ch modes can essentially be divided into three basic categories, namely, assive, active, and passive/active mixtures. Each of these categories can be further subdivided.

An example of the passive approach is given by simply pointing a radio telescope at a selected celestial body and trying to discover intelligence behind any signals that might be received. Small scale passive searches have already been made with negative results. Such searches are based on a number of assumptions. One of the most fundament and significant of these assumptions is that intelligent entities beyond the earth have thought patterns which are basically similar to those of human beings. This means that we operate on the basis that aliens would think of communicating along the same lines as we do and that the development of alien civilization would occur in a manner familiar to us from our own history. The means of coding and transmitting information used by an alien civilizations would thus be more readily recognizable by us than would be the case otherwise. On the other hand, it is possible that communication could be achieved in the passive approach even if forms of information transmittal currently unknown to humanity were used if existing human instrumentation could detect some aspect of the phenomena being used to transmit data. That is, events could turn out favorably if fortunate accidents should occur and there were investigators involved who could deduce the significance of the instrument readings. A classic example of an inadvertent discovery is the birth of radio astronomy as a consequence of the investigation into certain forms of radio interference by Bell Telephone Laboratory engineers.

It was in the September 19, 1959 issue of Nature, that Prof. G. Cocconi and Prof. P. Morrison published the first serious proposal that the search for extra-terrestrial intelligence should be initiated.(4) The basis of their proposal was that it is likely that there are civilizations elsewhere in the universe that are much older than human civilization. These civilizations may be awaiting some sign of the appearance of intelligence within the solar system which humanity occupies. Cocconi and Morrison assume that an advanced alien civilization would establish a means of communication with humanity and that such a civilization would wish to receive signals from any intelligence now [illegible] They felt the transmissions from an extra-terrestrial society would be composed of electromagnetic pulses. Considering the enormity of interstellar distances, it is reasonable to expect that a communication from an alien society would be lengthy and possibly require a transmission time of the order of years. The communication would contain attention-getting devices and a syllabus for learning the language of the transmission. Most of the message would comprise a detailed picture of the sender civilization. In order to increase the chances of some civilization receiving the communication, the signals would be sent simultaneously towards a number of stars.

More specifically, these two researchers proposed an actual listening program starting from the calculation that there are about a hundred stars similar to the sun of humanity within fifty light years. Three of the seven stars that are within fifteen years of the earth, appear from the earth to have the Milky Way as a backdrop. It is assumed that the extra-terrestrial civilizations would broadcast the 21-centimeter wavelength emitted by interstellar hydrogen. The backdrop emission from the Milky Way makes the radiation on the 21-centimeter wavelength coming from beyond those three stars forty times more intense than it would be coming from other portions of the sky. This makes radiation at that wavelength coming from the vicinity of those stars difficult to detect unless these signals are very strong. Those three stars are poor candidates for observation on this basis relative to the other four which four have less noisy backdrops in the southern half of the heavens.

The conclusion reached by Cocconi and Morrison was that it would be a worthwhile endeavour to search for signals from extra-terrestrial intelligences.

At about the same time that Cocconi and Morrison were making their proposal, Dr. Frank D. Drake of the National Radio Astronomy Observatory at Green Bank, West Virginia was actually making preparations for such a search.(4) The result of these preparations was the now famous Project Ozma. Two stars, Tau Ceti and Epsilon Eridani, were selected for listening. The radio telescope listened with its eighty five foot dish at the twenty one centimeter wavelength. No signals were received after a total observation period at Green Bank of one hundred fifty hours.

The listening proposal of Cocconi and Morrison and the actual attempt by Drake illustrate the passive approach to the detection of extra-terrestrial intelligence. It would be unfortunate if every advanced civilization in the universe were only listening instead of listening and sending. In the "listening only" event, the only hope of detecting another civilization would be by picking up the leakage from local transmissions that escape into space. To date, essentially all of the attempts to discover intelligent extra-terrestrial life on the part of both the United States and the Soviet Union have been passive ones. (The Viking missions were oriented toward ascertaining the presence of any sort of life of a type that would have some similarity to life on the earth.)

A national space policy should require a wide range of approaches to detecting intelligent extra-terrestrial life because of the tremendous import such a discovery could have on humanity. Such a space policy should express the general attitude toward searches for extra-terrestrial intelligences in a positive and constructive manner. There should be no hint in this policy of the attitude that extra-terrestrial intelligences should be regarded as sources for the salvation of humanity, by such intelligences taking responsibility for the development of humanity when such development is the sole responsibility of humanity. The Unidentified Flying Object (UFO) cults in the United States seem to espouse this point of view. Their attitude is that the destiny of humanity is not and should not lie in the hands of humanity itself because humanity does not and can not develop the capability to manage its own development. This kind of attitude is an immature one. It reflects a defeatist and fatalistic view of humanity which is not justified. Any formulation of national space policy should implicitly and explicitly present the point of view that the future of humanity and of the United States of America will be worked out in a serious and responsible manner by people in all walks of life.

It might be desirable for any formulation of national space policy to spell out the means by which extra-terrestrial intelligence will be sought. One sensible way to approach the search for alien civilizations over an indefinite period of time would be to think in terms of an evolution of techniques within the context of the entire program of the development of the extra-terrestrial environment by humanity. The initial techniques would be passive along the line of Project Ozma. Existing earth-based radio telescopes would be used. Additional such telescopes and telescope arrays would be constructed. After a period of passive listening, these telescopes could be used to transmit radio signals towards designated regions of the heavens.

Space-based radio telescopes would be deployed to join in the search. The first space-based radio telescopes used for essentially scientific purposes will probably be devoted to general radio astronomy. Part of the working time of these telescopes would be allocated to searching for alien civilizations.

Later on after the commencement of the operation of these telescopes it would be appropriate to have one or more of them wholly dedicated to the search. Eventually, extra-terrestrial radio telescopes would be constructed from the outset with their purpose solely being to look for possible neighbors. As with the earth-based telescopes, the ones in the sky would both receive and transmit.

Everything costs money. At what point in time would it be most economical to deploy these radio telescopes throughout the heavens to look for possible intelligent aliens? The answer to this question lies in the evolutionary point of view. The main thrust of any national space policy should be that the extra-terrestrial enviornment is to be subjected to a process of industrialization for the benefit of humanity. This process of industrialization has already begun. It began with the founding of the Communications Satellite Corporation (Comsat). In the near future, it is logical to believe that a more formal process of space industrialization will proceed earliest and most forcefully in the area of communications. Until the present, the emphasis in communications satellites systems has been to keep the satellites themselves as small and simple as possible while making the ground stations large and complex. A major reason for this is that launching such satellites requires considerable expense. They have to be made reliable enough to give dependable service over a period of years. It has not even been possible to economically repair communications satellites in orbit. With the advent soon of the utilization of the space shuttle, this situation will change dramatically. The United States of America will be able to put into space communications satellites much larger and considerably more complex than in the past. A number of companies including Comsat are contemplating doing so. The space shuttle will allow economies in launch costs and permit satellites to be repaired in orbit. These communications satellites will have much larger radio and microwave antennas than are now used. The larger the transmitting antenna in space becomes, the smaller the receiving antenna on the earth has to be and the less complex is the equipment required for amplifying earthside. This situation will allow direct broadcast from the satellite to users on the earth where this was not previously feasible. For example, it will be possible to send a television program from a satellite directly to a home without having to go through a ground station. Another possibility is to use the large transmission antenna of a satellite to broadcast signals to several thousand individual users via simultaneous transmission of several thousand pencil beams, one beam per individual, from that one antenna.

The technology that is used to make the large antennas for communications satellites can then be used to manufacture the first space-based radio telescopes. Eventually, the antennas of these telescopes will probably be much larger than those on the communications satellites but even if the pace of space industrialization does not directly unfold the precise technology to produce these increasingly larger telescope antennas it will require only a relatively small direct effort to obtain the additional technological knowledge.

As technology develops, it will become possible to consider means for contact with alien civilizations in addition to the radio telescope. Within a few decades, it will be possible to send out automated probes to the stars nearest to the solar system. (Making prognostications about the future feats of the United States of America is always a subject fraught with some difficulty. Historically, this nation has tended to overestimate what it can accomplish in the near term and to underestimate what it can do in the long term. In order to put matters in perspective, it should be noted that once the national commitment was made, it took only about eight years for this nation to put men on the moon and to safely return them to the earth. It is interesting to speculate how recent American history might be different now if President John F. Kennedy had decided to accomplish a more ambitious goal over a longer span of time, such as, for example, landing men on the planet Mars and returning them safely by 1980. Such an ambitious undertaking could in all likelihood have been undertaken successfully. The accomplishment of this goal would have reflected the spirit of a basically healthy and dynamic society.)

The decision as to when to send out extra-solar probes would again have to be decided in the context of the overall process of space industrialization and the progress of technology and science in general. The decision of the time question could be considered in terms of its components. One such component is the matter of the propulsion system for an extra-solar probe. In order to keep the flight time to the nearer stars down to a reasonable century or two, it will probably be necessary to use on-board nuclear energy for propulsion. The most efficient form of nuclear energy release now being developed is thermonuclear fusion. Thermonuclear fusion may very well be commercially available before the year 2000. This type of nuclear energy would be the best and probably the only feasible choice for driving an extra-solar probe with a relatively short flight time. There are a number of schemes under investigation for harnessing thermonuclear fusion reactions to commercial electrical power production. It is not unreasonable to believe that one or more of these schemes might turn out to be more adaptable for providing propulsion for a probe in a time shorter than the scheme could be adapted for providing power on the earth. Perhaps, in fact, an extra-solar probe could be used as a test bed for some type of thermonuclear fusion reactor. It has already been suggested that laser fusion could be more readily and earlier applied to such space propulsion than as a stationary electrical power source. Of course, various space industrialization activities could eventually use thermonuclear fusion power especially when these activities are occurring far enough from the sun so as to make the use of solar energy unfeasible. Thus, the development of thermonuclear fusion propulsion, for an extra-solar probe would not require nearly as much funding as might be thought since most of the work required for its development will have to be done anyhow for other thermonuclear fusion power applications.

Reliability as a whole and in all of its parts must be an important feature of an extra-solar probe. This is because it must carry out its functions and operate in flight and at its destination for a period of two hundred years or more without any maintenance and repairs being able to be performed. It must be able to reach its stellar destination, detect any planets, make physical and biological surveys of planetary objects, and search for any signs of extra-terrestrial intelligence. Finally, it must be able to communicate this data, presumably, by some form of radio, back to the earth. This order of magnitude of reliability is not absolutely required in earth industrial activities or even, in general, in most space industrial activities. Reliability increases are always sought after, however, whatever the field of endeavour being considered. It is not inconceivable that some space industrial installations of a complexity greater than that of an extra-solar probe will have to be emplaced in environments where routine operation by human beings would be inconvenient and dangerous to those personnel. In this event and for all industrial activities outside of this extreme case, the state of the art advances in reliability engendered by the development of the probe would pay back to society much more money than was spent for the reliability research. (It should be noted that there is a continuous feedback between any two spheres of activity. For example, it is possible to take the view that hazardous space industrial activities could lead to reliability advances that could be picked up by the probe project and be further moved forward to be of use by the probe. On the other hand, planners looking at potentially lucrative yet hazardous space industrialization projects at least partly because of reliability problems might decide not to go ahead with these projects. The existence of an extra-solar probe project with its concommitant reliability advances could then change the mind of those planners.)

Finally, consider a third major characteristic of an extra-solar probe, namely, that it must be capable of independent action to a degree heretofore not required by any other space mission. The reason for this independence requirement arises from the fact that the most rapid form of communications known to exist is that via the transmission and reception of electromagnetic waves. The limiting speed of transmission is the speed of light in vacuum. As the probe leaves the vicinity of the earth, the round trip time for signals to traverse the distance from the earth to the probe will gradually lengthen from seconds to years. It is thus necessary that the probe contain an advanced computer that can maintain the probe and direct its actions under all sorts of conditions without directions from the earth. The computer will have to have a component density higher than any computer has today both to minimize its speed of operation and to maximize the amount of information that it can store. The programming of this computer will also have to be more advanced than anything that now exists. The computer may well have to make decisions oriented toward the success of the probe mission under circumstances that may not even have been envisioned by its builders. Such a computer would have many valuable applications in the overall process of space industrialization. It is difficult to decide now which would contribute more to funding the development of the computer: various space industrialization projects or the probe project itself. (Another possibility is that in the normal course of research and development activities not directly related to the utilization and exploration of the extra-terrestrial environment such computer capabilities will be developed anyhow.)

The impact of any kind of contact with extra-terrestrial intelligence would be an enormously profound one for humanity. It is extremely difficult to predict just what the response would be to this information. One generalization that might be made is that the various groupings of human society would react according to their own backgrounds, histories, and characteristics.

If one looks back over the entire history of humanity, it turns out that the Jewish experience might very well offer the greatest amount of information and insight as to how humanity might react to and profit from contact with extra-terrestrial communities. Raphael Patai(5) has stated that there is no question but that the Jews have had more exposure to outside influences than any other people on the basis of the Jews having had the greatest variety, intensity, and duration of such exposure. There is also a basic qualitative difference between the Jews and the Gentiles as to how exposure to foreign influences have affected their respective histories.

Among the Gentile nations when one of these nations has been under foreign domination or occupation the external cultural influences were incorporated by the native nationals into the life of the nation only as temporary phenomena so that these influences resulted only in minor and gradual alterations in the national life. There is a preservation of the national continuity such that the identity of the national population conglomerate is maintained. Jewish history demonstrates an essentially contrasting reaction to external contact in the past two thousand years of Diaspora. Jewish groups were scattered among the Gentile nations and allocated positions in the interstices of the economic and social structures of these nations. This fragmentation resulted in constant exposure to the respective influences of the host countries. (One might perhaps consider this relationship between the Jewish fragmentation and the influence of the Gentile nations in analogy to a situation that arises in the physical sciences. Suppose it is desired to accelerate a chemical reaction in which a particular substance is involved. If this substance is normally found occurring as lumps of a relatively large size, fragmenting the lumps will speed up the reaction. This acceleration happens because the surface area of the substance is now increased so that the other reactants have more room on which to act.) There was a great impact with regard to housing, furniture, apparel, and food. In the intellectual sphere, the attractive components of this Gentile culture were assimilated and equalled or surpassed. In the pschological domain, if a Gentile characteristic was determined to be attractive it was adopted (e.g., the adoption of Spanish pride by the Sephardim), while if it was not attractive, the opposite characteristic was engendered (e.g., the East European emphasis on sobriety in relationship to the drunkeness prevalent among the Russian Polish peasants). Thus, while the Gentile mind is predominantly the consequence of internal cultural processes, the Jewish mind is the result of the two equally powerful forces of Jewish tradition and Gentile influence and of the tension between those two forces.(5)

There have been six major encounters which were of great formative influence upon Jewish thought and the Jewish mind. The first encounter which was with the inhabitants of Canaan occurred from the time of the first patriarchs about the seventeenth century B.C. to the Babylonian exile of 586 B.C. It was the Canaanite contact that resulted in the Jewish replacing of their Aramaic language with the language of the Canaanites, which Canaanite language became Biblical Hebrew. The Canaanite experience was a formative influence in the religious sphere and had a seminal affect on the Biblical period of Jewish history consequently affecting all of the later development of Judaism. The second encounter which was with the Hellenic world superimposed Greek on the Aramaic language which Aramaic was characteristic of oral communication and informal writing among the Jews since the fifth century B.C. Enduring from the late fourth century B.C. to the second century C.E., the Hellenistic contact made important contributions to the Biblical-rabbinic tradition and resulted in a Greek-Jewish hybrid of endeavours in the arts, literature, intellectualism, and religion. The Arab conquest in the seventh century of Southwest Asia and North Africa resulted in the third encounter. As a consequence of this encounter, Arabic became the language of most Jews. This Arabic contact stimulated the Jews to undertake great secular intellectual activities for the first time. Another result of this contact was that the Jews of Spain had a major role in the great Arab cultural developments. The Spanish Jews also aided in a significant manner the bringing of Hellenic science and philosophy to the Western world. The influence of Renaissance Italy from the fourteenth century onward constituted the fourth encounter. This encounter demonstrated the feasibility of the Jewish mind being equally comfortable both with its own traditional Judaism and, simultaneously, with a secular society. The development of Hasidic Judaism in the eighteenth century was the product of the fifth encounter which encounter occurred between the Jews of Eastern Europe and the sectarian movements of Christianity in Poland and the Ukraine. The result of the fifth encounter was that the Yiddish language became the carrier for a highly significant religious advance in Judaism. This advance marked a route away from the

Talmudic-halakhic(Jewish law) path which path had dominated Judaism since the earliest times. The sixth encounter was brought about by the Jews themselves in the eighteenth century when they voluntarily subordinated themselves to modern Western culture. This Jewish Enlightenment caused Jews to adopt the language of each nation that emancipated them in the nineteenth century. The removal of the cultural and social obstacles which had kept Jews apart from Gentiles resulted in the Jews becoming leaders and pioneers in Western civilization.(5) (The advocacy by B'nai B'rith of an accelerated process of expansion into and development of the extra-terrestrial environment can be viewed as a logical outgrowth of this sixth encounter.)

It is of particular interest to consider the relationship between these historic encounters and the role of science among the Jews. In the scientific fields of endeavour, the encounters over the course of centuries have produced a dramatic shift.

Although the Jews were affected by many aspects of Hellenic culture, they were quite unaffected by Greek science and did not participate in it to any significant extent. This situation seems to be particularly anomalous when considered against the background of the extensive Jewish involvement in philosophy, literature, and historiography. The apparent reason for this neglect of science among the Jewish intellectuals of Greek civilization is that these intellectuals were attracted only to those activities which could be used to demonstrate, support, and espouse Jewish excellence. For example, an epic or a drama could be used to convey the story of the life and accomplishments of some great Jew of the past. Works of history were used in a similar manner. Philosophy writings of the Hellenistic Jews were oriented toward expounding upon the unique worths of the law, morality, and monotheism of the Jews. However, the pursuit of science could not be used in a like manner.(5)

Subsequently, the encounter with Arab culture produced a radical change in the Jewish attitude toward science.(5) For example, until this encounter occurred, no Jew had studied astronomy or written an astronomical work, although Talmudic scholars used astronomy as an aid to religious observances. After the contact with the Arabs had commenced, from about 800 C.E. to 1300 C.E. the names of about a hundred Jewish astronomers in Arab lands are recorded. In the area of the applied sciences, the Jews made a significant contribution in the compilation and improvement of astronomical tables for use as navigational aids. Jewish mapmakers were also important. The Jews took a leading role in the continued development of Greek scientific concepts with significant contributions being made in the areas of mathematics, physics, medicine, and alchemy, in addition to astronomy.(6) Rabbi Jacob ben Makhir invented a navigational instrument which could be used to ascertain the altitude of the sun or a star aboard a ship. This device, known as Jacob's Staff, was used by the early Portuguese discoverers. The Jews also translated the works of Greek and Arab science into Spanish, Latin, and Hebrew, in this manner making these works available to Christian Europe.

The Jewish contribution to science during the Arab interregnum is illustrated by the work of the Spanish-Jewish scientist and philosopher Albraham bar Hiyya(5). His treatise Mensuration and Calculation is the first Hebrew work showing that the area of a circle is equal to pi multiplied by the square of the radius of the circle and the first known work (after the earlier Egyptian disclosure) to present the formula for a truncated pyramid. He produced a two part astronomical work, the first part being Form of the Earth and Figure of the Celestial Spheres and the second part being Calculation of the Courses of the Stars. Two other of his scientific works were the astronomical tables Tables of al-Battani and Book of Intercalation which latter work is the oldest Hebrew work dealing with calendar problems. He also translated Arabic scientific books.

The Jewish experience bodes well for healthy consequences for any contact that might occur with non-human intelligences elsewhere in the universe. Jewish history could be viewed as a spaceship voyaging among far and exotic worlds.

In fact, the possible consequences of contact with extra-terrestrial life and intelligences for Judaism and the Jews are already under study. Rabbi Norman Lamm, the president of Yeshiva University, upon examining the basic foundations of Judaism and the writings of famous scholars such as Moses Maimonides has come to the conclusion that extra-terrestrial intelligence poses no threat to Judaism.(7) Judaism is a religion of laws and these laws apply to any intelligent entity regardless of its form. Further, the tenets of Judaism do not depend on the uniqueness of humanity in the universe or upon the possible superiority or inferiority of humanity relative to any presumed non-human civilizations. The analysis of Lamm is supported by the analysis of Patai with regard to ascertaining the essentials of Judaism.(5) Patai feels that these essentials are two beliefs and two duties. One belief is that in one God and the other belief is the belief in the special relationship between Israel and God. One duty is that toward God and the other duty is that of one person to another. Both beliefs and both duties would be unaffected by contact with any extra-terrestrial intelligences.

From a psychological point of view, it seems reasonable to expect that it is more likely that positive responses would be found among the inhabitants of the earth if the contact process would occur under circumstances in which humanity plays an active role in the interaction with the extra-terrestrial civilization. It might be expected that the healthfulness, in general, of the response of humanity to alien contact would be in direct proportion to the amount of initiative displayed by humanity in the contact process. It could be expected, however, that the responses of the populace of the earth might be much more varied than those displayed by the Jews during their contact experiences. It is clear that contact will be occurring under the most healthful conditions for the United States of America and for humanity as a whole if contact were established while humanity itself was in the process of developing the resources of the extra-terrestrial environment for its own benefit. This is essentially a matter of pride and the feeling of self-worth.

In any case, although it is important that a national space policy have as part of its objectives research into the origins of life and the search for extra-terrestrial life and intelligence, the most important goal of such a policy should be the development of the resources of the extra-terrestrial environment for the benefit of the people of the United States. This development is commonly known as the process of space industrialization.

At this moment in time, the United States finds itself faced with a number of formidable difficulties. The economy is faced with an exorbitantly high rate of inflation. The productivity and efficiency of industry is nowhere near as high as is desired. There is far too great a dependence on imported petroleum for national energy needs. Millions of people require one form or another of social welfare. The physical environment of the nation has to be improved so as not to have an adverse effect upon the people. The transportation and communication systems require improvements. The defense system must have its capacity increased to deal with external threats to the interests of the nation. In order to meet and to overcome all of these troubles, a major increase in the national resource base is required.

Once more it is appropriate to turn to the experiences of the past in order to demonstrate that the space industrialization process is possibly the most healthy course to take of all the available courses of action which are open to the United States.

A. J. Toynbee has studied how societies can respond in different ways to the same challenge.(8) He gives as one example the response of the Aegean society and the Greek city-statesto over-population and associated problems which had developed by the middle of the eighth century B.C. At this time, industry had developed bringing with it wealth, luxury, and the promotion of slavery. A poletarian class had been created. With the growth of trade had come merchants which were a new middle class. The burgeoning cites required an increase in their food supply, the importation of raw materials from foreign lands, and markets for the products of their cities. Concurrently, the population of the Aegean world was undergoing a period of rapid growth. The desire to live well was denied to many, a situation that was aggravated by the nobles who denied the people political rights. A consequences of this denial was the growth of class consciousness and class hatred. There were antagonistic racial feelings between the Dorian lords and the Dorian serfs, particularly in the vicinity of the Corinthian isthmus. Not all of these factors were present everywhere in the Aegean world nor were some of these factors as active at that time as they would be somewhat later, but the common factor was discontent. The response to the overall situation varied among the Greek city-states.(9)

One response was colonization which simply expanded the geographical area of the Aegean world without changing the character of that world. About the year 7[illegible] B.C., colonists from Chalcis planted a colony near the bay of Naples in Italy. Later, Cumaeans accompanied by Athenians established Neapolis (subsequently to become known as Naples) near that Chalcidian colony. The Cumaeans grew abundant grain and manufactured vases and metal wares for export.

Other Chalcidian colonies were established on the north coast of Sicily, on the Italian side of the Strait of Messene, and on the opposite side of that strait.

Concurrently, the Achaeans of the northern Peloponnesus established Sybaris in the instep of the boot-shaped Italian peninsula. From Sybaris further expansion by colony and conquest resulted in the founding, partly by settlers from Sybaris, of Posidonia. Other colonies in this area were Locri and Croton. Laconia founded the very important colony of Tarentum in Italy. The Tarentines exported their vases and the products of their weaving and fine woolen dyeing throughout the peninsula.

Corinth was one of the greatest of the colonizing city-states. Perhaps the greatest of her colonies was Syracuse which was established in Sicily. Of the other of the Dorian colonies in Sicily, the most brilliant was Acragas.

The Aegean world was expanded to its natural limits through the establishment of colonies along the northern Aegean, the Hellespont and Propontis. Chalcis took the lead, with the participation of Eretria and Corinth, in the settlement of the Chalcidic peninsula. Among the Ionians, the city-state of Miletus is said to have founded eighty colonies in this region of which Cyzicus, Olbia, Panticapaeum, and Sinope were the most important.

The consequences of Greek colonization were very significant in that the surplus population of a virile group of people discovered an outlet, those in need obtained land, and trade increased. Colonization also allowed for a regular penetration of new ideas from other lands. It spread Greek culture among the people of the Mediterranean basin. In the history of Western civilization, the Italian and Sicilian Greeks were a highly significant factor in the development of Italy, and through Italy of central and western Europe.(9)

However, some Greek city-states found solutions to the problems of the eighth century B.C. which entailed significant changes in their ways of life.(8)

In the case of Sparta, the desire for land by her citizenry resulted in the attack and conquest of her closest Greek neighbours. About the year 730 B.C., Sparta took over the land of Messina and reduced its inhabitants to serfdom. After this conquest, Sparta founded the colony of Tarentum, an act which temporarily satisfied the wants of Sparta. At this point, Sparta essentially retired from the colonization process. Although the system of serfdom and the lack of colonization efforts set her somewhat apart from the other Greek city-states, there was no real reason why Sparta should not develop in a manner similar to those other states. Then, in the second half of the seventh century, the Messenians revolted. The Spartans thwarted the revolt and reimposed the institution of serfdom upon the Messenians. This revolt had, nonetheless, a profound impact upon the Spartans. The Spartans felt that they could not simultaneously lead a life devoted to commerce, agriculture, and the arts, and keep a population ten times their own in subjection for an indefinite period of time. In order to maintain the system of serfdom they ignored everything to the end of making Sparta a powerful military state. This transformation took only a few decades.(9)

A third kind of reaction to the circumstances of the eighth century B.C. was exhibited by Athens. Athens oriented her agricultural system for the export market and started a manufacturing system oriented in the same manner. The Athenian political institutions were developed so as to give an equitable share of political power to the new social classes which had been created by the economic innovations. The Athenian response thwarted the appearance of a social revolution by the initiation and carrying through of economic and political revolutions.(8) To use space age terminology, the highly important "spin off" of the Athenian approach for Aegean society was the opening up of a new mode of advance for civilization.

The career of Solon who became the archon of Athens in 594 B.C. illustrates the Athenian approach.(9) A harsh code operated in the interest of the great landowners at that time. Farms were mortgaged. The tenant farmers, who paid one sixth of their produce to the landowners, were discontented. Many freemen were in slavery for debt. Magistrates practiced embezzlement, plunder, and judicial oppression. Before the rise of Solon, some attempt was made to resolve these difficulties by war. The Athenians conquered Sigeum which conquest may have occurred in order to protect the route by which grain was brought from the Black Sea. This conquest indicates that Athens was already finding the resources of Attica inadequate.

To a great extent, Solon was successful in reconciling conflicting interests, in the process making possible security and stability in the future. Solon proclaimed the abolition of all securities on land and persons and set free those who had become enslaved. He prohibited any one from that time on offering the body of that person as security for a loan. He did not cancel ordinary commerical debts. He did make it easier to repay debts by shifting to a new standard of coinage. Debts incurred under the old standard could be paid under the new standard, the new standard being higher than the old one. In order to pay for imported grain, Solon decided to cultivate the olive so that its oil could be used as an export item. In order to encourage the industrial development of Athens, Solon arranged for artisans from other centers to be given citizenship provided that they came with their wives and children and settled permanently in Attica. Solon also limited the amount of land a person could own, opened the silver mines at Laurium, and revised the calendar. The law code that he developed was more fair and more definite than that of Draco. This new code was oriented toward freeing the individual from family and religious associations and producing a closer attachment to the state. In his revision of the constitution wealth was made the sole qualification for office. The result of the actions of Solon in the political sphere was that the people obtained some relief from oppression by the nobles and were set free from the fear of tyranny.

This Greek experience has some similarities to the situation which the United States now faces. Some people in this nation are emphasizing a Spartan approach to the difficulties of the country. This approach would entail severe constraints on individuals and would greatly reduce the options available for use as lifestyles. It is possible that the constitutional form of government would be eventually destroyed. Space industrialization offers a far more healthy route along the lines traversed by Corinth and Athens.

The initial phase of space industrialization would involve the areas of communication, remote sensing, and data acquisition and transfer. In these fields, space industrialization has already commenced. Communications satellites are a commerical proposition and Comsat is a highly profitable enterprise that gets more prosperous with the passage of time. Remote sensing satellites are still in the research and development stage but the process of bringing them to an operational status is underway. Data acquisition and transfer, such as from one computer to another and the transmission of information from an automatic station at one point on the earth to an analysis center at another point, is also being performed by the communications and remote sensing satellites. With the advent of the space shuttle, it is hoped and expected that there will be significant changes and increases, both qualitatively and quantitatively, in the activities of this aspect of space industrialization. The positive effects of this aspect upon American society in the near future should be much greater than in the recent past and important alterations in the lifestyles of Americans could be expected.

Once the space shuttle is in operation, it has already been noted in connection with space radio telescopes, communications satellites much larger and heavier than any such satellites now existing will be orbited. Eventually they will become so large that it will become necessary to use several space shuttle flights to orbit the components of a single communications satellite and assemble that satellite from those components in orbit. Such a great increase in size allows for an order of magnitude increase of all kinds of information channels and sizeable growth in the amount of power available for use by the satellite. This growth in capacity and capability could have a profound impact upon American society. The cost of transmitting and receiving a bit of information should drop sharply over a period of years. Receiving terminals could become smaller, more simple, and less expensive, in addition to being easier to maintain.

Consider now a company that has business of such a nature that requires the processing of great quantities of data. The typical concept of such a company is one wherein all of the people employed by that company perform their duties at a centralized location. The availability of copious and inexpensive communications channels beyond what now exists could change the concept of a work place. Only a relatively few people would work at the centralized location. Most of the employees could work in smaller facilities near their homes or even right in their homes. Terminals linking the outlying work facilities with the centralized location would allow for all of the data transmission required to undertake to perform the business of the firm. Conducting a business in such a manner would allow the central facility to be much smaller so that the capital investment required to build it and the operating expenses required to maintain it would be much less than otherwise. A considerable amount of time formerly used for commuting would also be saved. The business would be able to operate in a more flexible manner. It would be more simple to arrange for employees to work after the regular operating hours if the work load or emergency conditions should so warrant. The response time to react to critical situations during off-hours could be much shorter as compared to the situation with all facilities being centrally located because there would be much less need for transporting employees to the central location. Communication, in general, is a much more rapid process than transportation.

Remote sensing satellites, which are now in the transitional stage from research and development to operational, have already proved themselves to be valuable tools. For example, in the area of energy the SMS/GOES geostationary satellites have been used to ascertain the hourly distribution of sunshine over various portions of the land surface of the earth.(10) Using data from the visual spectrum, the cloud coverage and density were evaluated as a function of the time of day and season. The use of these satellites has provided information of major significance for the selection of sites for earth-based solar power stations. For example, these satellite studies have provided evidence that low density cirrus clouds impede the collection of solar energy less than other types of clouds. Further, it has been found that the morning and evening clouds are less of an impediment to sunshine than clouds that occur during the hours of maximum insolation at midday.

It is anticipated that in the near future, remote sensing satellites will be making many valuable contributions toward surveying, monitoring, and providing inventories of the resources and products of the earth, both natural and man-made. Since the announcement last year of the initial steps toward operational status of these satellites, plans have been unveiled for the intensive use of these orbital prospectors to search for new sources of petroleum and other minerals.

In the area of energy, space industrialization offers a number of possibilities. Perhaps the best known of these possibilities is the concept of the satellite solar power station (SSPS) which concept was originally proposed by Peter Glaser. Another possibility involves the utilization of giant orbital mirrors. Kraft Ehricke has recently discussed variants of the space mirror concept.(11)

One type of space mirror which Ehricke has proposed is called Lunetta. The mirrors of the Lunetta system are designed to provide nocturnal illumination of magnitudes appropriate for various applications. On a clear night, the lighting efficiency of the Lunetta at the ground would be about 64 percent of the light energy reflected from the mirror in space. For urban illumination, the Lunetta would provide better lighting with a reduction in electric power consumption and could serve as a backup in the event of brownouts, blackouts, and fog. The Lunetta could be used to illuminate strips between major metropolitan centers, such as the one between Boston and Washington, D.C. and the one between Sacramento and Los Angeles. Urban growth in many countries, especially growth in the developing nations, could benefit from night light from this space mirror. By providing lighting for industrial activities in remote areas of the world, it would render such activities more practicable. This lighting would render the oil, gas, and mineral deposits of Alaska, Canada, the Barents Sea, and the Atlantic Ocean in the Arctic region more accessible. Construction of large remote facilities such as solar and nuclear power plants, pipelines, power lines, and dams could be carried on more readily at night. The Lunetta could provide large-scale illumination of rural areas, aid in rural development, and provide the option of supporting agricultural and outdoor activities after sunset. It could help reduce the time required to cultivate fields between harvesting and planting for multiple cropping, provide for better utilization of shared farm machinery, and accelerate harvesting in the event of forecasts of inclement weather. Further, the Lunetta could provide disaster assistance in the form of night illumination for rescue operations.

The other space mirror system is termed Soletta.(11) The Soletta system provides a high level of solar energy flux upon a given image area. This flux can range from 0.25 to 1.00 of the energy intensity of the sun. The Soletta reflecting area is on the order of thousands to tens of thousands of square kilometers. There are two types of Solettas, the Powersoletta and the Biosoletta.

The mirrors of the Powersoletta provide supplemental solar energy input for earth-based solar-electric power stations. This system provides energy at night and enriched solar energy input during the day. This allows the operation of terrestrial solar power stations on a continuous basis independant of the day-night cycle. The orbits, numbers, and sizes of the Powersoletta mirrors would be a function of the sizes and distribution of the ground power stations. If there were a small number of terrestrial power stations distributed over a large area, the Powersoletta system would most likely be situated in a sun synchronous three-hour orbit.

The utilization of a three-hour retrograde orbit could allow parts of the earth which lack copious amounts of solar energy for power generation to create their own industrial suns.

In order to minimize local disturbances while maximizing the utilization of the radiative energy, the energy-processing areas should approximate the overall image area.

The Biosolleta system would be used to enhance organic growth by the stimulation of the assimilation of carbon by agricultural plants on the land and by plankton in the sea. The increase in plankton growth would lead to the growth of commerical seafood available as a source of protein to humanity. The areas illuminated by the Biosoletta when it would be applied to land farming would be smaller than for ocean application. This difference would arise because the land areas under contiguous cultivation are smaller as compared to the ocean area. Because of its application to ocean farming, it could well turn out that the Bisoletta could be best undertaken as an international program instead of as a national program.

B'nai B'rith recommends that the concept of space industrialization be the central feature of any space policy that is adopted by the United States Congress. Space industrialization would be supportive of all of the other possible goals of a national space policy. The concept of space industrialization would receive the broadest possible support of the American public as compared to other space goals.

A space policy should require that periodically an assessment be made of the worth or value of the space endeavours to the nation and to humanity. Such an assessment is a subjective matter. Thus, not only should space policy require this assessment, it should also supply some guidelines by which this assessment should be accomplished.

One possibility is to use a conventional cost-benefit analysis with standard discount practices for each project.(12) Sometimes apparently this approach would be seemingly appropriate although something additional should be required. For example, suppose experimentation resulted in the development of a process for making ball bearings of a superior quality to those made on the earth in a space manufacturing facility (SMF). One standard way, and the one most commonly used, to ascertain the worth of this space process as a commercial proposition would be to use the net present value (NPV) criterion. In order to perform the analysis a reasonable rate of discount must be determined so as to allow the calculation of the value of a certain quantity of these ball bearings in the present of the benefit to be obtained from these bearings at sometime in the future has been estimated. If the NPV for space ball bearings is greater than that for earth ball bearings all other things being equal, then investment in the space process is to be perferred. The higher the ratio of space NPV is to earth NPV, the more the space process is to be preferred.

However, this kind of analysis assumes some kind of normal market conditions. An industrialist needing to use ball bearings in his equipment perceives that ball bearings from space result in more friction-free equipment so that the equipment lasts longer than otherwise, resulting in a net savings to the firm of the industrialist even if the initial investment is higher than it would be with ball bearings made on the earth. The industrialist also notices that his energy costs per unit of production are less than they would be using the conventional earth-manufactured ball bearings. A significant datum has now been perceived. This product from space has now been linked with an extremely critical component of modern technological society, namely, energy.

To give a cost-benefit analysis for a product, process, or service in the content of a normal market economy is one thing. In the case of energy and energy-related activities, it does not suffice to give an assessment solely in terms of this type of market. An evaluation of such activities must be made in the context of the very survival and continuance of modern technological society. In this manner, the concept of energy security is introduced into the assessment process. This concept is analogous to the concept of national security. Dr. Paul J. Werbos of the DOE is the originator of the energy security concept and its application to the evaluation of space activities.(13) Werbos performed his initial work on the energy security concept as a member of the District Five Energy Committee of B'nai B'rith before moving on to DOE.

The analysis of energy security and its role in space activities assessment commences with the realization that in the time period between the present and the end of the twentieth century the only two energy sources to provide base-load power that are already developed and available for utilization and expansion are non-breeder nuclear fission power plants and coal-burning facilities. This is power that is required to run industry. Even if there is a determination by the Executive and the Congress to live with a reduced growth in the gross national product (GNP), the Department of Energy (DOE) estimates that by the end of the century the use of coal must be tripled and nuclear fission energy must grow by a multiplicative factor of eight. There is a direct correlation between GNP and energy production. Increases in efficiency of energy production and utilization mean more productivity for a given unit of energy input into the societal system so that less energy source material, such as uranium or coal, is required for a given increase in GNP. Even if anticipated increases in efficiency should materialize, the increase in nuclear fission and coal energy required to run this nation is substantial. Small-scale solar heating and cooling units will be of some aid in the residential segment of the nation but have very little impact on the industrial side.

The expansion of nuclear fission power facilities forseen by DOE between now and the end of the century can be accomplished without undue strain. The safety problems are manageable with regard to plant operations particularly since the increase in intensity with regard to handling such problems since the incident at Three Mile Island. The technology basically exists for long-term storage of high-level radioactivity nuclear waste below the surface of the earth. With the advent of the space shuttle and routine and reliable earth-to-orbit operations the additional option of waste disposal in the extra-terrestrial environment is also becoming more attractive.

Beyond the turn of the century, the situation for nuclear fission energy becomes somewhat difficult. Within the confines of the United States of America there is only a limited amount of uranium. Unless fission breeder reactors are developed and deployed in sufficient numbers within the next few decades, nuclear fission could not be depended upon for the long-term unless this nation started importing large quantities of uranium from other countries. This sort of dependency is what the United States is now desiring to avoid. With the utilization of breeder reactors based upon the consumption of both uranium and thorium the supply of fissionable fuels can be greatly increased. As time goes by, however, it would become more difficult to find appropriate storage sites for high-level nuclear waste, although it might be a matter of several centuries before this situation became really critical. It might be possible and even necessary to put all nuclear waste into the extra-terrestrial environment.

Possibly the major argument against the extensive use of nuclear fission power beyond the twentieth century, lies in the possibility that any particular reactor dedicated to the provision of energy to the people in whatever country such a reactor might exist could have its original objective modified so as to have it provide fissionable material for weapons. Some kind of international arms control agreement with strict enforcement provisions could ameliorate this situation so that nuclear fission could be a more attractive energy source in the twenty first century.

The situation with regard to coal is more pessimistic as compared to nuclear fission. The National Coal Association estimates that under the most favorable conditions it would be possible to increase coal output by only 25% between now and 1985.(14) This is in contrast with the desire of President Carter to expand coal production from the estimated 740 million tons in 1979 to a yearly rate of 1.2 billion tons in 1985. Larger increases in coal production could be achieved by 1990 or 1995 by massive stripping of Western coal near the surface of the earth. The land could be restored after such strip-mining activity but it would require considerable labor and expense. Although some people talk glibly about American coal reserves lasting for several hundred years, if attention is fixed on surface coal the increase in coal production called for by DOE demonstrates the falsity of this point of view. It is highly probable that the goal of tripling coal production by 1995 will not be met. This means that there will be a shortage of coal simply because of the inability to sufficently expand coal production facilities. Beyond 1995, the actual depletion of coal reserves will become an increasingly important factor. Other obstacles will also become more important after 1995. As time goes by, shortages will become greater and greater, after 1995. The result of this situation will be a magnification of the economic situation that now exists. That is, prices will rise at a more rapid rate than will income. At this point in time, i.e., 1995 or so, the Federal government will not be able to take any retro-active action or combination of actions to reverse the course of events.(13)

The environmental problems engendered by such a large increase in the use of coal are worse than those problems presented by nuclear fission. It is not uncommon nowadays to see newspaper articles on the effects of acid rain, a condition which results from the burning of coal. The quality of prime agricultural soil is already being lowered under the effects of such rain, according to the Environmental Protection Agency (EPA). The most profound long-term effect of the burning of coal is that engendered as a result of the release of large quantities of carbon dioxide into the atmosphere. This carbon dioxide would produce the phenomenon known as the "greenhouse effect". This effect arises when the earth receives radiant heat energy from the sun as the earth does continuously. The presence of this additional carbon dioxide would tend to prevent the re-radiation of the energy absorbed at the surface of the earth back into space. This would lead to a global rise in the temperature of the atmosphere. Further, additional environmental compromises will have to be made upon the advent of a large increase in coal utilization because of such factors as the expense of disposing of solid wastes and procuring low-sulfur content coal. The soil will incur damage from these compromises. The environment could probably maintain its integrity under the impact of all of these adverse effects for the remaining years of the twentieth century. However, almost surely, continued growth in the utilization of coal would cause a reduction of food production and a deterioration in the quality of the environment. This leads to the thought that the concept of "food and soil security" should be taken as seriously as the concept of "energy security".

It thus becomes necessary to consider alternative sources of energy that could be economically deployed in the time period of 1995 to 2020 that would obviate the need to make any great increase in coal utilization. Dr. Werbos considers several energy alternatives.

One possibility is the nuclear fusion.(14) Since the achievement on July 4, 1978 by the Princeton Large Torus of a temperature of sixty million degrees for one-twentieth of a second, there has been an upsurge in confidence in the magnetic confinement approach to fusion. Further fusion developments have occurred. At Oak Ridge National Laboratory, it has been found that more deuterium can be ignited in a confined space than theoretical calculations had indicated. This is significant because the power output from a plasma is proportional to the square of the density which means that doubling the density quadruples the power output. The Oak Ridge scientists have also made larger and more powerful neutral beam injection devices.

The Tokomak Fusion Test Reactor at the Plasma Physics Laboratory of Princeton University should be in operation by 1981. It is anticipated that this reactor will demonstrate the feasibility of magnetic confinement fusion in 1983. Feasibility will be attained by the achievement of a fusion reaction rate that yields more energy than in being put into the device. When the energy input to the machine is equal to the energy output from it, then the energy break-even point has been achieved.

The current Department of Energy (DOE) plan is to spend an estimated fourteen billion dollars to have the first commercial fusion reactor operating in 2005 and the second one operating in 2015, with the United States having a network of such reactors operational in 2025. Taking into account the brisk rate of progress of the past two years, it has been proposed that the investment should be increased to twenty billion dollars so that commercialization could occur ten to fifteen years sooner. B'nai B'rith supports the higher level of funding.

The tokomak approach is probably not the best approach to magnetic confinement fusion so that B'nai B'rith feels that more funding should be allocated to develop these other approaches. The electric utilities have also expressed similar concerns. Once the first generation of fusion reactors is on-line, it will undoubtedly serve as a spur to the deployment of a considerably improved second generation. The second generation may use different fuels and operate at higher temperatures than the first generation. These more advanced fusion reactors should be more reliable and easier to maintain than the earlier ones. In any event it seems reasonably assured that about the beginning of the twenty first century, nuclear fusion will start to supply a significant portion of the base-load electrical energy required to run the United States and to help satisfy the legitimate materialistic needs and desiresof its citizens.

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The second alternate energy source worth considering is earth-based solar power. This alternative comprises a number of possibilities. Israel has developed the solar pond. This involves the use of salt-laden layers of water in order to reverse the normal temperature gradient that would exist in a body of water. An experimental facility which generates electricity already exists in Israel. Arrays of photovoltaic cells can also be used to generate electricity. Another way to generate electricity is by concentrating solar energy with mirrors on to boilers and sending the resulting steam through turbines which drive generators.

Solar energy can also be used without being turned into electricity. Solar heating and cooling units for residential dwellings can be a valuable supplement allowing for some substitution of this form of energy for oil. Israel is in a leadership position in this application. Further, solar energy can be used in various industrial processes.

However, pure earth-based solar energy (without assistance from orbital mirrors) has some very real constraints on it which prevent this energy source from providing the sort of base-load power which an industrial United States requires. For example, solar energy is a diffuse source of energy so in many cases for it to be useful a considerable amount of land must be utilized to collect sunlight. This fact among others occasions the result that DOE makes helpful forecasts with regard to earth-based solar energy although these forecasts do not provide enough of a solar energy contribution to displace the requirement for continued growth in coal utilization. Earth-based solar energy is also faced by weather and day-night cycle constraints which constraints raise a storage question which must be answered. The large amount of land required, however, is the main problem. The area of land needed gives rise to severe environmental problems. Cost per se is not a problem.

The third alternative energy source considered by Dr. Werbos is the satellite solar power station (SSPS). The SSPS offers much more promise for providing base-load electrical power than does earth-based solar energy while at the same time it has much less of an environmental impact. There have been several variants of the SSPS discussed since Dr. Peter Glaser originally proposed it about fifteen years ago. The SSPS that is most often considered is a very large satellite in geosynchronous orbit. One way of collecting and converting the solar energy is with many square miles of photovoltaic cells. Another way is to focus the sunlight with mirrors and generate electricity in the conventional way with turbines and generators. Up to this point the process of getting electricity to the consumer is similar to that involved in earth-based solar energy.

The next stage of the SSPS concept involves converting the electricity produced onboard into low-density microwaves. These microwaves are beamed down to a receiving station on the earth where they are converted back into electricity. The electricity is then distributed through a network of transmission lines.

The SSPS concept has a number of advantages over earth-based solar energy. An SSPS in space is almost continuously exposed to sunlight and is immune to the twenty four hour long day-night cycle. There are no weather problems. The problem of storage when there is no sunlight does not occur. Since most of the energy conversions in the SSPS process with their accompanying heat losses occur above the atmosphere of the earth, thermal pollution from an SSPS in the biosphere could be less per unit of energy output compared to almost all other energy sources now being considered including earth-based solar energy. The microwave receiving antennas would be mostly open space so that most of the land at the reception site itself would be available simultaneously to grow crops. The low-density microwaves used for transmission should have a minimal effect on the biosphere.

Just one of this most commonly discussed type of SSPS could readily supply more than enough electrical power for New York City or Los Angeles. There are alternate proposals for the SSPS that do not involve such large satellites. James E. Drummond of Maxwell Laboratories, Inc. and Ronald N. Drummond of the National Space Institute have proposed an SSPS based upon the use of smaller satellites in lower orbits than the geosynchronous orbit.(16) Drummond and Drummond feel that these lower iso-insolation orbits, one at plus 45° and the other at minus 45° to the plane of the ecliptic, can better attain the potential of the SSPS concept. Instead of having satellites delivering 10,000 megawatts to 5,000 megawatts each, their proposal deals with satellites delivering 200 megawatts each. They have introduced a new mode of power conversion into the SSPS dialogue. This mode is called the cascaded dielectric power converter. These researchers feel that the power transmissions from their satellites would produce less of an effect on the ionsphere than would the transmissions from the geosynchronous, larger size satellite SSPS network. Their conclusion is that their SSPS concept could yield power at the ground with a rate of only six mills per kilowatt-hour.

One possibility that makes the SSPS concept even more attractive is the idea originally proposed by Prof. Gerard K. O'Neill of Princeton University that most of an SSPS could be made from lunar material. Dr. Brian O'Leary of Princeton University has broadened the O'Neill approach to include the utilization of asteroidal materials. If only one or a few power satellites are under consideration, it is less expensive to lift all of the components from the earth. However, should events get to the point where it is desired to construct an SSPS network sufficiently large as to supply a significant portion of base-load electrical power to the United States, then the extra-terrestrial materials approach could very well lead to major cost reductions in the SSPS construction program.

Under the original concept of O'Neill a mining facility would be established on the moon. This facility would be highly automated so as to require a minimum number of personnel for construction and maintenance. The unprocessed lunar ore would be launched into space. In the O'Neil concept the launcher is an electromagnetic catapult called a mass driver. The lunar material would be captured by a space manufacturing facility (SMF) which SMF might be constructed at a Lagrangian libration point. At the SMF the ore would be processed and turned into SSPS components.

Anther possible way to use the moon for energy purposes would be simply to turn the moon itself into a truly gigantic SSPS. In this event, the refining and component manufacturing would occur on the moon. Thousands of square miles of solar cells could be laid out on the lunar surface in a pattern that insures that a sufficient number of cells was always exposed to sunshine. The power from these cells could be transmitted to one or several power relay satellites (PRS) in geosynchronous orbit which satellites would then send the power to the earth. The feasibility of this lunar emplacement approach to the SSPS is in part a function of what other uses of the moon develop.

The three possibilities of thermonuclear fusion, earth-based solar power and satellite solar power each present their own difficulties with respect to research and development, but they all deserve encouragement at the highest levels of the federal government. The research and development required should be planned with an emphasis on the practical application of these sources so as to allow deployment of these sources as soon as possible. In order to attain the highest probability of reducing the growth in coal utilization before the adverse effects from such use become too severe, the probability of success of the research and development should be maximized and the time needed to implement the technology should be minimized for all three possibilities. Since the lead times are so long for developing these three alternatives, any delay in the present could become very serious in the future. A "critical path" is a course of action such that the performance or non-performance of a component of that action in the present can have an effect in the future in both monetary and non-monetary terms which is far greater than the cost in both monetary and non-monetary terms of that component in the present. Especially for the SSPS there are small items that may be on the critical path which require special attention now. These critical path items must be identified. After this identification is made, adequate funding must be obtained in order to secure these items in an expeditious manner.(13)

In particular, the approach of Prof. O'Neill toward deploying an SMF capability adequate to sustaining an SSPS construction program is deserving of more serious consideration than it is now given. His more recent modifications to his original thoughts comprise what he terms the "low (profile) road to space manufacturing".(17) This road starts with a method by which the space shuttle could be improved to the point of having an operational capability up to geosynchronous orbit. It continues with planning for a minimal facility on the lunar surface which would mine and launch materials into space at low cost. The third milestone on the road is the evaluation of a processing and fabrication facility in space. The fourth component of this road is the calculation of the input factors needed in order that the space facility become self-sustaining and productive.

O'Neill suggests that space shuttle external tanks be carried all of the way into orbit on space shuttle missions to serve as reaction mass after the empty tanks have been ground into a fine powder. The powder would then be accelerated and ejected by an adaptation of the electromagnetic mass driver which modified mass driver would be attached to whatever payload that it is desired to send into an orbit higher than the nominal space shuttle orbit. In this way additional reaction mass to go above low earth orbit would not have to be brought up from the earth. Another possibility, thinking along the same lines as O'Neill, is that space shuttle tankage be formed into small pellets and then have these pellets accelerated and ejected by a rotary centrifual force type of device. Both possibilities may present some environmental difficulties although the O'Neill suggestion appears probably to be the safer of the two proposals. In any case, O'Neill is thinking along the right lines by trying to maximize the utilization of all of the components of the space shuttle even when these components are usually considered to be waste after their original purpose has been fulfilled. It is possible that O'Neill and others will develop better ways in which expended space shuttle tankage could be used to attain higher earth orbits.

In considering the minimal lunar facility, the external space shuttle tanks also enter into the picture. These tanks would be converted into lunar habitats for the personnel building and operating the facility. Initially, there would be no attempt at processing any material on the moon itself. The facility would simply dig up lunar ore and sling it into space. Power for operations would be obtained from photovoltaic cell arrays. Lunar soil could also be used as reaction mass.

The next step in the development program involves the chemical processing of the raw lunar material at an SMF. One significant consequence of this processing would be the rendering available of lunar oxygen for propulsive purposes by lunar landers and thus further reducing the cost of the overall operations. The chemical processing could be based on a carbo-chlorination reaction instead of the previously considered carbothermic reaction studied in earlier SMF investigations. This shift in systems reduces the earlier estimate of the peak temperature in the SMF processing system by a thousand degrees which reduction leads to a peak temperature about equal to normal industrial practice on the earth. After chemical processing, the next step would be fabrication at the SMF. The initial limited range of products could include photovoltaic arrays and thermal radiators. Later, structural components could be fabricated. The selection of the initial products to be fabricated would be decided partly on the basis of their utility in upgrading the lunar facility and the SMF. There are various possible modifications to the scenario of O'Neill. For example, a steady increase in the requirement for power on the moon could lead to building a chemical processing facility on the moon and the manufacture of photovoltaic cells right on the moon.

O'Neill defines the ignition point in his program to be that point at which the total lunar facility/SMF system output would be equal in mass to an SSPS production rate of two ten thousand megawatt stations per year. At this point, the minimum transport investment would have come to approximately a total of 300 flights from earth to low orbit of which over half would be space shuttle flights with the remainder being space shuttle-derived lift vehicle flights. At the ignition point, agriculture in the extra-terrestrial environment would not yet have been established. The range of output products and the rate at which these products would be diversified would be determined on the basis of economics. If a product manufactured in space is cheaper than the same product brought from the earth then economic forces indicate that the space manufacturing route is the way to go.

In any event, the SSPS shows as much promise as thermonuclear fusion in terms of providing enough power output to meet the basic requirement of hindering the growth in the use of coal as soon as possible after 1995. Earth-based solar energy does not show as much promise as fusion in this regard but earth-based solar energy could deliver enough of a contribution to make it well worth funding also. Werbos and B'nai B'rith have arrived at this conclusion without the assumption that any of these three major alternatives to coal is guarenteed to succeed. Since these three options all have elements of uncertainty associated with them, the concept of energy security requires that all of these options must be taken seriously. This approach would minimize the risk that no alternatives to coal utilization would be developed and be available after 1995. (Risks associated with the use of nuclear fission power generation would take a far greater time to grow in order for these risks to approximate the risks associated with the combustion of coal.) Further, since time is of the essence there should be considerable testing of equipment and apparatus and theoretical, experimental, and operational research far in advance of any firm commitment to any of these alternatives. In addition, commitment to any one alternative should not preclude commitment to one or both of the others. This is in keeping with the old adage about not putting all of the eggs that one possesses in a single basket.

The application of the concept of energy security to the SSPS requires that work start now on matters that are critical to the SSPS. For example, as has been pointed out already there are two main routes by which an SSPS could be constructed, namely, by lifting all of the requisite components from the earth or by obtaining most of the components from the extra-terrestrial environment by use of appropriate processing and manufacturing techniques. To date, a number of theoretical studies as to the merits of both of these approaches have been made and their relative merits have been compared with each other. The general consensus is that at some point in time with the construction of a sufficiently large SSPS network it becomes more economical to traverse the extra-terrestrial route and that the economies continue to grow after that point. However, the exact point in time and the exact number of satellites in the SSPS network at which the break even point is obtained is subject to considerable dispute.

One example of a study comparing the earth-lofted approach with the extra-terrestrial material approach is that of R. H. Miller and D. L. Akin of the Massachusetts Institute of Technology.(18) In their study, they measure productivity in terms of kilogramsof finished product per hour of direct labor. With the assumption of highly automated production systems, they assign productivities of 250 kilograms per hour for assembly in space, 50 kilograms per hour for refining on the moon, and 2500 kilograms per hour for mining on the moon. They consider two cases. One case is the assembly of an SSPS in low earth orbit (LEO) from terrestrial materials and transporation of the completed SSPS to geosynchronous earth orbit (GEO). In the second case, materials are refined on the moon but the components are manufactured and the SSPS assembled in GEO. In the event of net system productivity of fifty kilograms per hour the crossover point at which the extra-terrestrial approach becomes more economical than the earth launch approach occurs after the construction of about ten satellites in the SSPS network. At this point the total cost for the SSPS network will be about one hundred billion dollars.

A more detailed study has been made by the Convair Division of General Dynamics under contract to NASA.(19) In this study, it is assumed that one ten-gigawatt SSPS will be built per year over a period of thirty years. The study considers three variations of the lunar resource utilization scenario and compares these three variants from the economic point of view with construction of the SSPS from earth-lifted components. The factor that is used for comparison is the average cost in terms of dollars per kilowatt of installed capacity. After an uncertainty analysis is performed for the various cases, including those where the manufacturing costs are the same and where these costs are different for earth-lifted components as compared to components space manufactured from lunar material, it turns out that there is a range of about 57 percent to 93 percent probability of the lunar utilization approach becoming more economical by the time thirty power satellites have been produced.

Of course there is much more work that has to be done even in the theoretical study stage in addition to further investigation as to the mode of construction for an SSPS network before a decision can be made as to whether or not to proceed with the deployment of an operational SSPS system. However, "paper" studies can only go just so far. Somewhere along the road hardware testing and development in the extra-terrestrial environment itself must commence. Possibly the most cost-effective route for the process of space industrialization to take particularly from the point of view of space energy development and the utilization of extra-terrestrial resources is through combined military and civilian endeavours.

B'nai B'rith feels that, although it might be a somewhat controversial stance to take, the prime directive of a national space policy that space be developed for the benefit of the nation requires that the military side of the society be allocated a role in the space industrialization process. If one considers the research and development required for making a decision with regard to making an operational SSPS, then possibly the optimal course lies in combining the concept of energy security with the concept of military security. The further generalization upon considering all of space industrialization and not just the SSPS is the combining of the concepts of extra-terrestrial resource security and of energy security with the concept of military security.

The mandate under which NASA operates allows it to carry out only civilian activities. It is not, however, forbidden for NASA to work with the Department of Defense (DOD). In fact, NASA is now working closely with DOD on the space shuttle. DOD is studying how to make the best use of the space shuttle to perform DOD missions. In general, DOD considers space technology as one of the alternatives to be explored when the question as to the implementation of a national defense mission has to be decided upon. If the extra-terrestrial approach to solving a problem turns out to be better than any other, then DOD chooses the space approach. A national space policy act should require that joint military-civilian ventures in the extra-terrestrial environment be undertaken to the maximum extent possible.

In order to illustrate the effectiveness of a joint NASA-DOD approach to the development of space, it is of immediate interest to consider the area of intelligence gathering. Reconnaissance satellites are the most important source of data for the intelligence agencies of the United States. A recent Congressional report states that the reconnaissance satellite technology of this nation has stagnated with respect to the equivalent technology of the Soviet Union in the past several years. The major reason for this stagnation is the budgetary difficulties of NASA. Improvements are necessary for reconnaissance satellite technology because of the turbulent world situation. It is essential that the data collecting capabilities of such satellites be significantly increased. This increase in data collecting ability is particularly important because of restrictions that have been imposed on earth-based collection posts and the need to police possible arms limitation agreements.

The next generation of reconnaissance satellitesthus must utilize satellites much larger than are the present ones. The size requirement arises from the necessity of these future satellites having to bear a greater variety of sensors, a larger array of any particular sensor, processing equipment of a more sophisticated nature, a larger quantity of processing equipment, more satellite maintenance equipment, and a significant increase in power generating capacity. In order to obtain a three-dimensionaleffect, some sensors may have to be mounted hundreds of feet apart from each other. In order to increase resolving power, various types of sensor arrays may have to be spread over areas of thousands of square feet. All of this means that these satellites will have to be constructed using very large space structure technology (VLSST).

At the moment, VLSST exists only as a number of theoretical studies and a few pieces of equipment. (One piece of equipment is a prototype beam builder made by the Grumman Corporation in Bethpage, Long Island.) Utilizing the concept of joint military-civilian space ventures as applied to reconnaissance satellites, NASA would be given sufficient funding to develop VLSST to the point of having actual demonstration satellites in orbit by 1985. (Maintenance of a tight schedule is of considerable importance considering what the international situation is like nowadays and what could transpire in the near future.) To show the benefits of VLSST to the civilian segment of society, one or more of the demonstration satellites could be devoted to such a purpose as earth resources surveys with observation capabilities far beyond those of the yet to be launched LANDSAT-D.

While NASA had been working on the development of VLSST, DOD concurrently would be given funding to do design work and components fabrication (wherever this would be possible) for the new reconnaissance satellites so that as soon as VLSST was successfully demonstrated DOD could move into action. This action would consist of DOD getting additional funding which it would give to NASA, in order for NASA to loft into orbit via the space shuttle, the DOD constructed components of the reconnaissance satellites, which NASA would then proceed to assemble into operational constructs for the DOD. After the reconnaissance satellites were assembled, the duty of routine operation of these satellites would then be turned over to DOD.

Another area for cooperation between NASA and DOD is the development and deployment of orbital solar power sources delivering outputs of hundreds of kilowatts. NASA has a number of possible uses for such power units in the 1980-1990 time frame. Such units could be used to run pilot space manufacturing facilities. They could also be used to power a demonstration SSPS. DOD could use solar power units to drive a prototype orbital directed radiation weapon which weapon could be tested as an anti-intercontinental ballistic missile defence. If a number of standardized power units were available, the economies resulting from standardization could allow the testing in orbit of a variety of directed beam weapons without incurring an exorbitant cost. Another use that the DOD might have for these power units would be to run reconnaissance satellites with active sensor systems, such as powerful radar systems which could probe the earth below.

Both NASA and DOD could use some kind of orbital transfer vehicle (OTV) and even, perhaps, several types of OTV in order to conveniently provide maintenance for their respective facilities in space. An OTV could be designed to function in both manned and unmanned modes. DOD could also use an OTV to inspect possible hostile orbital mechanisms. Such an OTV could be armed in case it were necessary to take action against an enemy orbital device.

Another joint NASA-DOD project could be the construction and operation of a manned low earth orbit space station (LEOSS) by about 1986. If it were too much of a strain on the NASA charter, NASA and DOD would each have to operate their own LEOSS. (It might be desirable to pass legislation modifying the NASA charter so as to allow one jointly operated LEOSS.) If it were not possible to have one LEOSS, than NASA would demonstrate the requisitetechnology by building an LEOSS of its own and then constructing an analogous facility for DOD. In any event an LEOSS would be used to perform experiments on a routine basis and provide regular support for other orbital operations. Its operation would effect economies in space activities when the pace of such activities exceeded a certain level. Another significant aspect of an LEOSS would be a psychological one. People all over the world could gaze at the sky and see a permanent presence of the United States of America looking back down upon them.

The introduction of the utilization of lunar and/or asteroidal resources for extra-terrestrial construction purposesmight perhaps most effectively be undertaken through a joint NASA-DOD development program. As the pace of defense activities in space quickens and as more civilian facilities operate in orbit, there will be an increasing need to protect all of these operations.

Sometime before 1990, VLSST facilities and solar power units will have been deployed and experience gained with them. Possibly a modification of an OTV could be adapted for use as a lunar lander. Then, before 1990, a small mining facility could be emplaced on the moon. This facility would simply dig up lunar material and fling this material to some convenient point in space where it would be captured. Initially, there would be no attempt to refine the material. An OTV system would pick up the material and deliver it to the orbital facilities which require protection. The material would be deployed about the orbital facilities in its unrefined state to provide protection for these facilities. Essentially, the only property of the lunar material that would be used at this point would be its mass. This approach to the utilization of extra-terrestrial materials could give early operational data as to how to handle such materials in the preliminary stages before refinement and manufacture and also give information as to the economies that could be obtained in these preliminary stages and the economies that could be obtained later with more sophisticated lunar utilization. (It is possible that astronautical advances in the next decade could allow an early operational assessment of utilizing asteroidal material in a manner analogous to the utilization of lunar material. This might entail the actual retrieval of an asteroid of appropriate mass and of an appropriate velocity relative to the earth and the subsequent placement of this asteroid into an orbit about the earth.)

The advocacy of dual military-civilian development of the extra-terrestrial environment is in accord with the relative priorities which Werbos assigns to space projects oriented toward the production of energy.(13) The top priorities of Werbos are, first, the completion of research and development of the space shuttle and the bringing of it to operational status as soon as possible and, second, the development and deployment of an OTV (whether it have a solar electric drive or some other type of propulsion unit) without delay. The next highest priorities are those critical components where particular design choices are required. The first of these components is the demonstration of manufacturing techniques for refining extra-terrestrial materials all the way from original form through to solar cells. This demonstration is important to future research and development decisions. The next priority is the development and construction of the LEOSS. The priority after the LEOSS is the development of the components on the critical path leading to the mining of lunar resources.

The views of Werbos in support of increasing and sustained funding for energy-related space activities apply to all space endeavours. The advocacy of a balanced budget is opposed by Werbos and by B'nai B'rith because those areas of the budget which are more likely to be attacked are those which involve investment to increase national productivity and the national resource base. An unbalanced budget with deficit spending can very well be a far more effective fighter against inflation than can a balanced budget. A steady investment increase over the years in a broad-based exploration and utilization process for the extra-terrestrial environment will yield benefits to American society, financial and otherwise, far exceeding by many orders of magnitude the original investment. The placing of investment in space endeavours in opposition to social welfare programs is fallacious, misguided, and damaging to the future of the United States of America.

Investment in the extra-terrestrial domain will open up new fields of employment for many of those persons who now have to subsist on welfare programs. It may take some training so that people can take advantage of these opportunities but people can be trained. In the case of energy-related space activities, such activities will result in keeping prices of products and services, such as food, energy, and transportation, lower than they would be in the absence of such activities. In this connection, it should be noted that the costs of basic products and services are more important proportionally to people aided by the social welfare programs than in the case of more affluent persons because welfare people devote a higher proportion of their budget to these basic needs than do more affluent people.

It can even be stated that investment in the extra-terrestrial domain will avoid situations of "infinite inflation" with regard to certain products and services. This situation would arise if someone wanted a certain product or service at a given time but it did not exist. At a given point in time, if something does not exist, no amount of money will purchase it at that time. For example, all of the money in the world could not have been used to purchase a television set a hundred years ago. Such a situation could arise in energy and other areas important to the individual and to society.

A balanced cost-benefit analysis of energy-related space activities and, indeed, of all space activities, must take into account all of the factors, financial and non-financial; which have been brought to light. Essentially, this cost-benefit analysis should avoid the "penny wise, pound foolish" way of thinking. Werbos has presented a resonable approach to this kind of cost-benefit analysis in his article "Changes in Global Policy Analysis Procedures Suggested by New Optimization Methods and Required for Global Survival."(20) In this approach, Werbos argues that the use of discount rates in the decision-making process is invalid in critical situations under which the fabric of society is threatened.

A recent report by the United States General Accounting Office (GAO) confirms the point of view of Werbos and of B'nai B'rith with its very title "U.S. Must Spend More to Maintain Lead in Space Technology" lending emphasis to what must be accomplished.(21) After recognizing the role of technological innovation in making significant contributions to the growth of productivity of the nation and to increasing the national economical health, the GAO report makes a statement that strongly supports the role of the federal government in stimulating innovation. The report deals only with the space manufacturing aspect of space industrialization. The space manufacturing aspect of space industrialization can have a beneficial impact upon the economy even before actual products are manufactured in orbit, according to the GAO. The first phase of space manufacturing comprises materials science research in the extra-terrestrial environment. The knowledge obtained in this phase could be used to improve earth-based processes and products developed in the terrestrial environmental before manufacturing operations begin in orbit.

The GAO report has particular significance if it is considered within the context of the formulation of a national space policy. The comments it makes with regard to space manufacturing and the federal government are essentially valid for all aspects of space industrialization. Basic research entails the expenditure of investments on a high risk and long term basis. Space manufacturing is now in the basic research stage. Basic research in space for materials science studies is more expensive than similar basic research on the earth. American industry is reluctant to undertake this basic research in the extra-terrestrial environment. This situation means that the dominant role must be accepted by the government in terms of the government having the willingness to commit and risk sufficient resources to attain success and remain competitive with other nations. These resources should be used to conclude the necessary basic research, fund a major portion of the developmental and demonstration research, and provide for the construction of the facilities, including transport services, required for the undertaking of extra-terrestrial activities by American industry. The GAO report notes that it is too early to predict specifically what products and processes will develop from materials research in space. The economic worth of these products and services is also difficult to predict. However, the social and economic consequences of this space research could very well be tremendous according to many scientists.

Werbos comes to four conclusions as a result of his study of approaches to policy analysis in circumstances where society is subject to great strains and sudden changes.(20) The first conclusion is that essentially all of the decisions of the federal government should be made with the explicit aim of survival of society being the overriding factor. This survival factor override should enter into both national and international decisions. The second conclusion is that the use of interest rates to assess future benefits should be replaced by the use of shadow priceswhich prices would be explicit functions of both socioeconomic conditions and time. The third conclusion is that although reliance solely on market mechanisms does not suffice to give reasonable assurance of societal survivial, any attempt to plan the future in a deterministic manner is even less satisfying than the market mechanism approach. The fourth conclusion is that it is necessary to develop an open set of explicit designs and contingency plans in order to give assurance to both rendering accurate estimates of the shadow prices and of meeting the requirements for the survival of society. By an open set is meant that the set can acquire more plans and designs and/or subtract plans and designs and/or modify plans and designs that are already part of the set as the dicatates of time and circumstance so warrant.

The quantification of the approach of Werbos to cost-benefit analysis would be undertaken through the utilization of a variant of dynamic programming (DP).(20) DP is based upon the solution of the Bellman equation (BE). The BE is used to compute a strategic utility function (SUF) from a known intrinsic utility function (IUF). The IUF is a measure of the intrinsic value of a situation to society of being in that situation at a certain point in time. In the long term, it is desired to maximize the sum of the IUF over all of the future periods of time. The SUF is descriptive of the worth of being in a particular situation at a particular time taking account of both the intrinsic value of that situation at that time and the ability to move from that situation to future situations of increased utility. In order to assure the maximization of the total utility of the IUF, it is only necessary to maximize the SUF in the immediate future.

Suppose now that cross roads phenomena must be taken into consideration. It is, of course, necessary that such phenomena be taken into consideration It must first however be recognized that the concept of a crossroads phenomenon must be defined. In the context of this analysis, a crossroads phenomenon is an action which could have a significant effect upon the survival of society as it is now constituted.

The initial move towards taking account of crossroads phenomena in dynamic programming was undertaken by Howard. This move was a generalization of the BE by the introduction into this equation of a function which represents the long term expected value of utility if the optimal strategy is followed. This function is actually a constant. With the introduction of the Howard constant it turns out that the concept of foresight has been introduced into the dynamic programming methodology. Foresight means that it is not necessary to discount the future. Under the original concept of dynamic programming the utilization of the discounting approach was usually necessary in order to avoid meaningless infinities when the sum of the IUF is taken over all future times.

However, even the generalization of Howard does not suffice for true crossroads phenomena. In many cases, the value of a Howard function is a constant for a given strategy. It is a constant which is independent of the initial state. This means that the same long term expected value of utility will be attained irregardless of the particular situation from which the optimal strategy is begun. A true crossroads phenomenon in the sense that it is a phenomenon which represents a true crossroads of history is a phenomen in which the expected value of utility in the long term is not only a function of the strategy followed but that this expected utility value is a function of the initial state. In other words, the Howard function which is a constant independent of the given situation must be replaced by a variable function, as has been accomplished by Werbos, which function is dependent upon the initial state.

In order to consider how a crossroads phenonema operates on a qualitative, basis it is of interest to consider an extreme example within the context of the determination of a national space policy. Suppose that there are two possible initial states. Sometime within the coming year it is decided to completely terminate all space activities, both civilian and military, by the United States. This constitutes one possibility. On the other hand, suppose the United States decides to accelerate its civilian and military space efforts on a regular and sustained basis. This constitutes the second possibility for the initial state. The optimal strategy is pursued in both cases with the aim of maximizing the energy, natural resource, and national securities of this nation. The long term expected value of the intrinsic utility could turn out to be very different with regard to the two possible initial conditions.

In the zero space activity case, the United States could windup in a situation wherein the nation collapses catastrophically to a more primitive state because of an insufficient amount of energy. This could occur because all of the earth-based energy possibilities might not be able to be emplaced rapidly enough to keep pace with a rising demand for energy. Perhaps an SSPS network or giant orbital mirrors could have made the difference between collapse and non-collapse. From the natural resource point of view, again even utilizing the optimal strategy the nation could collapse. Recycling of materials is never a completely perfect and efficient process. It could be difficult to develop synthetics to replace conventional materials. In any case, whether or not synthetics are utilized a closed-system world would sooner or later encounter increasingly severe materials problems. The importation of extraterrestrial materials by the earth in the long term could mean the difference between the survival and non-survival of both American and world society. Another possibility for catastrophe could arise from the point of view of national security if even pursuing the optimal strategy the United States were effectively wiped out of the position of being a world power by a military action on the part of the Soviet Union. The military action would have been a success because non-satellite means of acquiring intelligence information did not suffice for the United States to effectively forestall Soviet military action.

Now consider the accelerated space activity case. With this initial condition, it could turn out that an SSPS network and/or other energy and energy-related space options might help put the United States in an energy secure position together with the aid of earth-based energy sources. With regard to the natural resource aspect, the acquisition by the United States of asteroidal materials in vast amounts could render it independent of resources from other countries which countries could have interests basically inimical to those of the United States. Again, the decision to accelerate all space activities could put the United States in a position while it is following the optimal strategy such that its space reconnaissance capabilities allow it to thwart any military actions on the part of the Soviet Union. The military space capabilities in this scenario would be a potent aid in the implementation of United States foreign policy.

B'nai B'rith firmly believes that it is important that any national space policy should provide for the assessment of space activities in terms of the impact of such activities on the long term survival of both American and global society along the lines proposed by Werbos.

Another type of assessment that also should be considered for inclusion in any formulation of space policy is one in which the impact of space activities on the rate of innovation in American industry is gauged. Innovation is one of the major factors affecting productivity. This assessment would not deal directly with long term survival and could be considerably less complex than the Werbos scheme. An assessment along the lines discussed by Tom Lee and Louis L. Wilde would be appropriate.(22)

The basic model of Lee and Wilde is one wherein there is an industry containing a certain number of firms. These firms are all in competition to introduce a new technology. This situation is modeled as a noncooperative game. It is assumed that the company which is first to introduce the new technology reaps all of the reward. The reward is a fixed sum. (In the earlier work of Loury(23) it is a flow.) The time to the introduction of the new technology for any particular company is a random variable. The costs of research and development for a particular firm are broken up into two kinds. One cost is fixed and incurred at the beginning of the program. The second cost endures through the life of the program and is a flow cost which continues until this company or another introduces the new technology on the market. The expected costs and expected benefits can then be ascertained for the firm.

For any given technology, the approach of Lee and Wilde could be used to study the most effective means in terms of minimizing time and investment for introducing this technology into an industry and into the nation as a whole. Their methodology could be used to study the question as to whether the research and development should all be done by the federal government, by one particular company, by the federal government and one company, by the federal government and several companies, or simply by several companies. This approach could serve as part of the basis for the evaluation of extra-terrestrial projects so as to permit judgement as to the proper funding level in terms of the social benefits to be obtained. It could also be used to aid in the determination of the appropriate funding level for a space project in terms of competition from other nations.

The approaches of Lee and Wilde and of Werbos are essentially complementary to each other. It is possible that the Lee and Wilde technique could be modified to take into account the long term goal of societal survival. For example, the Lee and Wilde approach is sensitive to how the research and development programs are funded.(22) Their approach is a development of the basic model of Glenn C. Loury.(23) In the work of Loury the cost of the research and development by any given firm is paid in one lump sum at the beginning of the program. This mode of funding differs from that of Lee and Wilde. As a consequence of these funding differences, Lee and Wilde arrive at two conclusions that differ from those of Loury. Loury finds that as the number of companies in an industry increase, the equilibrium level of company investment in research and development decreases. Lee and Wilde come to the conclusion that research and development increases. Loury finds that when the research and development technology has initial increasing returns to scale then an industry equilibrium with a finite number of companies with zero expected profit always results in research and development technology with excess capacity. Lee and Wilde find just the opposite result with regard to excess capacity. The methodology of Loury and of Lee and Wilde utilizes what could be considered a very elementary type of dynamic programming.

The appropriate assessment technique for a given extra-terrestrial activity would be a function of the scope, type, and size of that activity. A project to develop commercial production of a pharmaceutical material in the free-fall environment might be best assessed by the Lee and Wilde approach. An SSPS research and development program might best be assessed by a combination of the Lee and Wilde and the Werbos approaches. A program of indefinite duration to contact extra-terrestrial alien civilizations could very well be best evaluated by the Werbos technique.

There are two space policy bills under consideration in these hearings on United States civilian space policy and space applications for which this testimony has been prepared. One of these bills is the National Space Policy Act (NSPA) of Representative Brown of California. This bill should be examined with the criteria in mind for a space policy bill as B'nai B'rith views these criteria in this testimony.

B'nai B'rith feels in general agreement with the findings and policy sections of the NSPA. However, there should be a greater sense of urgency expressed in these sections as to the pace of expanding the national resource base by incorporating the extra-terrestrial environment into the structure of this nation. One specific point of the policy portion of the NSPA should definitely be omitted. This is the part in which the statement is made that the United States will not make any claims to sovereignty in the extra-terrestrial environment. B'nai B'rith believes that this statement of sovereignty renunciation is definitely not in the best interests of the nation. Such a statement could render it difficult to acquire extra-terrestrial resources of importance to the United States.

The goals outlined in the program part of the NSPA are in general consistent with the B'nai B'rith point of view. Some clarification could be wished for with regard to the phase "achieved, as soon as possible consistent with the efficient and prudent use of public funds" in section 5(b) and the phrase "achieved, as soon as possible consistent with sound scientific procedures and the prudent use of public funds" in section 5(c). If the intention of these phrases is that funding for space activities should be limited only by how rapidly and effectively the agencies undertaking these activities could absorb and utilize the funding, then B'nai B'rith fully supports these phrases. B'nai B'rith believes that this interpretation of these funding statements would allow the federal budget allocated to these space activities to rise to the much higher levels than now exist which levels B'nai B'rith deems it necessary to attain, and to maintain the growth of the federal space budget continuously and consistently. An increase in the funding for civilian space activities of twenty percent per year for the next ten years with the possibility of greater increases per year after that ten year period is considered reasonable by B'nai B'rith.

B'nai B'rith also feels that the portion of the NSPA dealing with program planning, implementation and reporting should have some sort of provision for assessments of space activities along the lines of Werbos and of Lee and Wilde.

The other proposed legislation set for consideration by this hearing is the National Space Policy Act of 1979 (NSPA9) of Representative Dornan. It is essentially similar to the legislation proposed by Representative Brown. One difference, however, between NSPA and NSPA9 is that NSPA9 includes aeronautical activities in with the space activities. B'nai B'rith believes that all references to aeronautical activities should be deleted from NSPA9. The main reason for this request for deletion is that there is no comparison between activities in the thin skin of atmosphere surrounding a single small planet and activities encompassing the entire cosmos. The inclusion of aeronautical activities with space activities lessens the overall impact and significance of NSPA9.

Another facet of NSPA9 which is questionable from the B'nai B'rith point of view is that facet which deals with manned exploration and settlement of other bodies than the earth within the Solar System. Although B'nai B'rith itself has even more ambitious goals in mind for the settlement of humanity throughout the Solar System, it doubts the wisdom of NSPA9 explicitly stating the exploration and settlement goals that it does. At this point of time, many of the people of the United States and much of American society are essentially in a negative and depressed state of mind. People operating from within such a frame of reference are basically concerned only with the "here and now" and with "bread and butter" issues. The concept of space industrialization intrinsically involves ultimately human settlements throughout the Solar System in order to bring ever greater benefits to the people of the earth. The explicit statement of human settlement per se throughout the Solar System as a national goal would tend to alienate many people. There is probably nothing to be gained by retaining the manned exploration and settlement statements in NSPA9. B'nai B'rith recommends that such statements should be omitted. Perhaps at some time in the near future the national outlook might become more optimistic and positive, so that a separate policy statement could be proposed boldy declaring imaginative and ambitious goals for the manned exploration and settlement of the Solar System by the United States. Such a future policy statement concerning the destiny of humanity in the extra-terrestrial environment could be considered as another Declaration of Independence in the sense that eventually these future explorers and settlers will be able to satisfy all of their needs independently of their home world.

B'nai B'rith also feels that the section in NSPA9 which discusses funding requested for air and space development and activities is inadequate. The minimum funding requested is too low. The minimum funding requested, if it is felt that this sum should be tied to the gross national product (GNP), should be no less than one percent of the GNP. However, B'nai B'rith feels that it is not wise to closely connect funding for the exploration and development of the extra-terrestrial environment to the GNP. Funding for space activities should be drastically increased and should keep growing on a continuous basis.

The statement in NSPA9 as to the United States rejecting any a priori claims with regard to appropriating any portion of the extra-terrestrial environment is somewhat vague because of the use of the phrase "a priori". If "a priori" is taken to mean that the United States feels free to claim possession of a portion of the extra-terrestrial environment if this nation goes before any other nation to that portion and has Americans living and working there, then B'nai B'rith is willing to accept this statement. In order to be on the safe and cautious side of the appropriation issue, however, as in the case of NSPA, B'nai B'rith believes that it would be best to delete any reference to ownership of portions of the extra-terrestrial environment. The ownership question might be more appropriately addressed in a separate policy statement dealing only with this issue. The United States cannot afford to have its rights to access to any sources of benefits, services, and natural resources restricted in any manner.

On the whole, as in the case of NSPA, B'nai B'rith is essentially in agreement with the goals expressed in NSPA9. However, in both of these pieces of proposed legislation, there is no conveyance from the B'nai B'rith point of view of the proper sense of urgency with regard to the development of space activities. The exploration and development of the extra-terrestrial environment should become a foremost item of priority of the United States.

In conclusion, B'nai B'rith feels that the United States of America needs a civilian space policy that is far more aggressive and ambitious than is now expressed by the current space activities of this nation. The new space policy should be centered about the concept of space industrialization, with additional components of the policy strongly supporting scientific research and exploration, such as the search for extra-terrestrial life. B'nai B'rith finds that both of the space policy bills under consideration at these hearings, that of Representative Brown and that of Representative Dorman, are acceptable to B'nai B'rith and that both bills could be improved by incorporating the recommendations and suggestions of this testimony.

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Checkpoint

Harriet B. Kurtz (1915-1977) Founding Editor
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SPECIAL DELIVERY

informal communication for

CHAIRMAN DON FUQUA
SPACE SCIENCE AND APPLICATIONS SUBCOMMITTEE
HOUSE SCIENCE & TECHNOLOGY COMMITTEE

cc: Mr. Darrell Branscombe
Subcommittee Staff Director

Dear Chairman Fuqua:

To assure the full spectrum of pro and con and creative discussion, you may consider it in the public interest to publish the enclosed letter relating to your hearings on "U.S.Civil Space Policy" July 23 & 24, as part of the record of the hearings. This is left to your judgment.

Former Chairman of the Science and Technology Committee, Olin E. Teague, asked Dr. Robert A. Frosch for a personal evaluation of our strategic studies. Dr. Frosch brought together twelve top NASA executives for a two hour review and discussion based on our audio-visual briefing. Dr. Frosch then wrote the attached supportive letter to Chairman Teague dated February 8,1978.

More recently former Chairman of the Senate Committee on Science and Technology Frank E. Moss has experienced our greatly improved audio-visual, and then written the attached letter.

Key persons from the National Security Council Staff, the Joint Chiefs of Staff, and elsewhere in the Executive Branch have come here for four and five hour relaxed discussion of this audio-visual. These have been OFF THE RECORD sessions because discussion of this subject is not tolerated in the top levels of the National Security Council.

I continue to offer to make the audio-visual available at your convenience. One major barrier from your point of view is that it would be a waste of your time to set aside less than two hours for the session. The audio-visual lasts 50 minutes. You will be free to end the discussion earlier. If I communicate well, you may wish to talk longer. If our studies prove to be valid, the future of humanity may be in your hands at this crucial moment in runaway world crisis.

respectfully HOWARD G. KURTZ

Howard G. Kurtz

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June 2, 1980

Mr. Howard G. Kurtz
War Control Planners, Inc.
Box 19127
Washington, D. C. 20036

Dear Howard:

I appreciate your letter of May 10 and I too am sorry that I had to leave before you had completed your audiovisual presentation. My reaction was positive on the lecture. I thought it moved faster and became better as it went along. No doubt you have given this lecture to many groups and therefore know how to pace and adapt the presentation. It would be marvelous if hundreds and thousands or even millions of people could hear that story and see the slides.

Your message is particularly timely because of the sudden push for more expenditures and greater armament in the United States. It seems as though the President and the Congress are both pressing for military expansion. I wish that I commanded enough credibility that I could turn our efforts to greater utilization of our technology to monitor movement toward war, visable to everyone. And thus to encourage nations to act in unity to preserve the peace rather than to arm to repel an attack from neighbor nations.

As you point out, the only real hope for mankind is, build a civilized world order that makes obsolete the continuing yo yo swings of war and peace, with war becoming ever more terrible and complete.

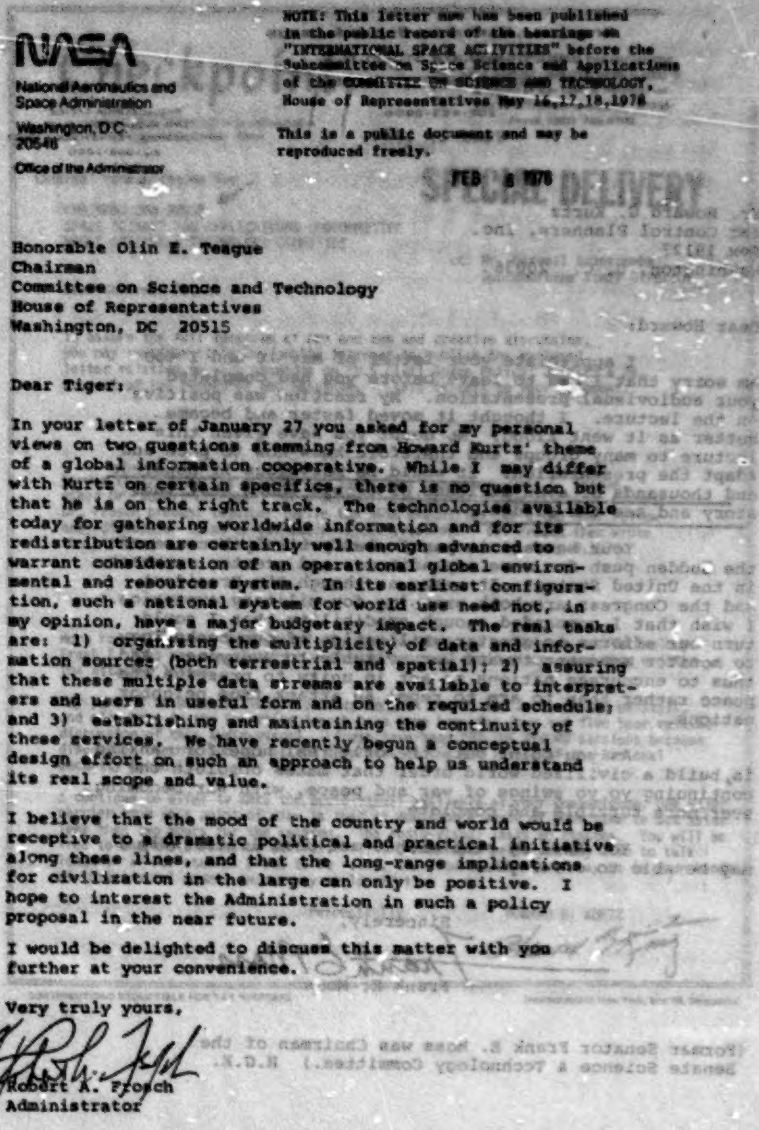
You have my best wishes and what little help I may be able to offer you.

Sincerely,

Frank E Moss

Frank E. Moss

(Former Senator Frank E. Moss was Chairman of the Senate Science & Technology Committee.) H.G.K.



NOTE: This letter now has been published in the public record of the hearings on "INTERNATIONAL SPACE ACTIVITIES" before the Subcommittee on Space Science and Applications of the COMMITTEE ON SCIENCE AND TECHNOLOGY, House of Representatives May 16,17,18,1978

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NASA
National Aeronautics and
Space Administration
Washington, D.C.
20546

Office of the Administrator

FEB 6 1978

Honorable Olin E. Teague
Chairman
Committee on Science and Technology
House of Representatives
Washington, DC 20515

Dear Tiger:

In your letter of January 27 you asked for my personal views on two questions stemming from Howard Kurtz' theme of a global information cooperative. While I may differ with Kurtz on certain specifics, there is no question but that he is on the right track. The technologies available today for gathering worldwide information and for its redistribution are certainly well enough advanced to warrant consideration of an operational global environmental and resources system. In its earliest configuration, such a national system for world use need not, in my opinion, have a major budgetary impact. The real tasks are: 1) organizing the multiplicity of data and information sources (both terrestrial and spatial); 2) assuring that these multiple data streams are available to interpreters and users in useful form and on the required schedule; and 3) establishing and maintaining the continuity of these services. We have recently begun a conceptual design effort on such an approach to help us understand its real scope and value.

I believe that the mood of the country and world would be receptive to a dramatic political and practical initiative along these lines, and that the long-range implications for civilization in the large can only be positive. I hope to interest the Administration in such a policy proposal in the near future.

I would be delighted to discuss this matter with you further at your convenience.

Very truly yours,

Bob

Robert A. Frosch
Administrator

Checkpoint

NEWSLETTER FROM THE FRONTIERS
OF A FUTURE CIVILIZED WORLD ORDER
A Project of War Control Planners, Inc.
Box 19127, Washington, D.C. 20036
Phone (202) 785-0708

Harriet B. Kurtz ([illegible]-1977) Founding Editor
Howard G. Kurtz – Editor

July 26,1980

The Honorable Don Fuqua, Chairman
Subcommittee on Space Science & Applications
House of Representatives
Washington D.C. 20515

cc: The Honorable Larry Winn,Jr.
Ranking Minority Member

The Honorable George E. Brown, Jr.
Chairman, Subcommittee on
Science,Research & Technology

(Witnesses)

cc: The Honorable Frank Press
Science Advisor to the President
The White House

The Honorable Robert A. Frosch
Administrator,National Aeronautics
and Space Administration

The Honorable Hans Mark
Secretary
Department of the Air Force

Dear Chairman Fuqua:

In appreciation of your leadership in holding public hearings July 23 & 24, 1980 on "U.S.Civil Space Policy", may I be permitted to offer constructive suggestions regarding testimony of the distinguished witnesses, and questions by the distinguished members of the subcommittee?

The following oversimplifications are based on more than thirty years study,writing and publishing in the field of the Kremlin/White House science,technology and national power race, jointly with my wife Harriet beginning with graduate study at The Russian Institute at Columbia University (1946-48) until her death June 17,1977.

Your hearings come in the advanced stages of a Crisis in Command of American Power. We wrote of today's crisis in May 1969 MILITARY REVIEW, Journal of the U.S. Army Command and General Staff College under title " The Collapse of U.S. Global Strategy ".

Today's paralysis of leadership in the White House and the Congress is related to the failure to choose among three historic options for advancing U.S. science, technology and power command

1. Committed to weakness in the face of growing clear & present danger
2. Committed to winning the race for the Power of Death for humankind
3. Committed to pioneering the Power of Life for people of all nations.

" It is premature to commit again to a high challenge, space engineering initiative in the order of complexity of Apollo " (the commitment to take men to the Moon and back safely within ten years, made by President Kennedy) (from testimony by Dr. Frank Press at the above hearing July 24,1980)

I not only totally disagree with Dr. Frank Press' advice to the President & Congress. I suggest that a far higher and far larger commitment of the creativity,power and character of the American people is at least fifteen years overdue. Time has been running out and it soon may be too late.

As President Kennedy refocused public attention away from the Cuban Invasion fiasco by the awesome commitment of American national power to make the Moon safe for human visits within ten years . . . .the person who delivers the Presidential Inaugural Address on January 20,1981, and the Congress, can refocus world anxieties away from the self-generating race for weapons capable of obliterating world civilization, and the runaway global crises in hunger,disease, terrorism,pollution,poverty,illiteracy and chaos, by a historic commitment of American research,development,testing, demonstration, and experimental operation for the next twenty or thirty years to the pioneering of LIFE SUPPORT SYSTEMS FOR PLANET EARTH . . . .world-sized systems , management structures, and legal institutions to guard the national security,political independence and economic development of all 157 or more sovereign nations (as Air Traffic Control guards the safety and progress of ALL airplanes in a cloud).

There is no way today to predict how many years may be required to establish that the people of all nations will be able to trust such unprecedented systems and institutions with the defense and development of their own native land. One thing is certain:- there will be no "peace" and no "disarmament" anywhere in the world until AFTER such prohuman institutions are in eventual operation . . . as no one airplane in a cloud can find safety and progress except under Air Traffic Control providing these identical services to all airplanes, large and small.

There has been and is a black hole, or crushing vacuum, in White House and Congressional vision. The U.S. has failed to produce a unified and coherent civil space policy, because it has failed to produce a unified and coherent national science and technology policy (hearings on this now scheduled by the Subcommittee on Science, Research and Technology for July 29-30-31) because it has failed to produce a unified and coherent objective,purpose and strategy for American national power in raging runaway world crisis.

For the first time America has failed to produce political or moral leadership adequate to the threat to our future. May I explain, from the following outline:-

I. THE CREATIVE COMMAND OF U.S. NATIONAL POWER

II. RESPONSIBILITIES,INADEQUACIES & OPPORTUNITIES OF THE SCIENCE & TECHNOLOGY COMMITTEE

III. ADVANCING TECHNOLOGY AND THE COLLAPSE OF AMERICAN NATIONAL POWER

IV. TO DEFEAT SOVIET EXPANSION WITHOUT RESORT TO WAR
The High Commitment to a New American Purpose
. . .in addition to meeting all requirements for national defense
. . .without having to "negotiate" with or beg permission of the Kremlin

23 concrete national projects which should have been on the agenda for this week's hearings

Transforming Goddard Space Center into a Window to a Worthwhile Future

A GLOBAL INFORMATION COOPERATIVE - a high commitment within reach today.

I. THE CREATIVE COMMAND OF U.S. NATIONAL POWER

A war is not lost on the battlefield. It is lost long in advance in the inadequate concepts in the mind of the Commander-in-Chief . . . the Hitler . . the Napoleon . . the Republican or Democratic recent President of the United States, surrounded by and held intellectual captive by, national security,foreign policy,military and science & technology advisers who are committed to the lures of protracted conflict, escalating defense expenditures, and ever-increasing national insecurity.

The nation which will emerge to provide inspiration and leadership for all other nations in the coming generation will NOT be the superpower continually "winning" the race for weapons capable of threatening the rupture of world civilization for a thousand years . . .and will NOT be the superpower turning weak and disarming in the face of growing clear and present danger from hostile world forces. Rather, it will be the major nation(s) capable of meeting needs for national defense, AND IN ADDITION capable of pioneering the world-wide military and civilian systems and institutions to bring to the people of ALL nations the national security, political independence and economic development for which the American people fought and won their War of Independence more than two hundred years ago. For the first time in history, advancing science, technology, management and other skills have made this objective feasible as a long-long range development experiment.

The President and Congress can facilitate the breakthrough to new power realities, only through a highly specialized management and legislative process. As President Roosevelt and Congress (1) prosecuted World War II through conventional command channels AND IN ADDITION (2) through utterly different and simultaneous channels mobilized the creative power of America in the Manhattan Project for the hitherto "impossible" task of releasing the power of the atom . . . . . for the past fifteen years American Presidents and Congress have had the capability to (1) meet all defense requirements through the conventional National Security Council and Staff and the Joint Chiefs of Staff AND IN ADDITION (2) through utterly different and simultaneous channels, electrify public opinion in all nations, including our own, by the high commitment of a new generation of American leadership in all fields to the hitherto "impossible" task of developing the prototype operational models of new world-sized structures (more complex and effective than the present United Nations)for a future civilized world order.

In words which any high school student or parent can understand:- for the coming generation American Presidents and Congress will have to be in command of two different kinds of superior national power. . .like a successful football coach.

They will have to maintain command control of SUPERIOR DEFENSE POWER to prevent opposing forces from breaking through to their goal of world domination. But a football team or a nation with no greater vision, no greater purpose than defense-only plays, in time will lose the confrontation. For more than fifteen years White House defense policy has caused the U.S. slowly to lose ground on the strategic power field.

IN ADDITION . . . . American Presidents and Congress will have to create and maintain SUPERIOR FORWARD POWER gradually in the coming years to move all confrontations down the field toward the distant strategic goal of a civilized community of nations free from war and free from want. There must be a great and noble goal. . . a truly high purpose.

As the Manhattan Project was created as an instrumentality of government IN ADDITION TO command channels for World War II, Congress will now have to authorize and insist upon an unprecedented World Order Council (in addition to and separate from the essential National Security Council) reporting personally to the President . . . and reporting to the American people through their Congress . . . to release and guide and support a generation of Americans in the FORWARD PLATFORMS of leading edge research and development and experimental operation on the far frontiers of future MILITARY-TECHNICAL-POLITICAL-DIPLOMATIC-LEGAL-ECONOMIC-SOCIAL-MORAL and other professions required for successful operation of the foundations for a planet of nations at peace, permanently. America's great national resource, its global systems professions and industries and managers will again be committed to the task they do best:- pioneering utterly complex global command,control,communications, intelligence (C^3 I)and other operational systems.

The grand new high commitment will NOT be to escape from the Earth into explorations, industries and communities in outerspace, as being pushed by the financial/industrial interests seeking multibillion dollar government contracts. Rather the commitment will be one that can be felt "in the gut" by human beings of all races, colors,creeds, nationalities and economic status . . . . .valid reasons for hope for a future,here on Earth.

Later I will suggest, for pro and con and creative professional,public and political discussion . . world-wide . . .twenty or more concrete global impact, high commitment projects the United States could have unleashed, and which could have been the subject for discussion at your hearings this week. But first, may I focus attention on

II RESPONSIBILITIES,INADEQUACIES & OPPORTUNITIES OF THE SCIENCE & TECHNOLOGY COMMITTEE

Space technology provides a proven leading edge, setting the pattern for a unified and coherent national science and technology policy, and in turn setting the pattern for a unified and coherent objective,purpose and strategy for American national power in raging runaway world crisis.

Congress shares an equal responsibility with the White House for the paralysis of American Power. Because technology is at the core of our national confusion, the Science and Technology Committee has rare and unusual responsibilities to the Congress as a whole and to the American people.

The Speaker of the House of Representatives is not permitted to assume leadership into new concepts of power. His office has explained to me that the initiative for such new power concept must come first from the Chairman of a major Committee of the House. Only after the Democratic Steering & Policy Committee lends its support to the Chairman raising the subject of a new power initiative, can the Speaker of the House take public action in this new field. The Chairman of the House Science & Technology Committee may today hold the key to the future of humanity, in his hand.

1. Any one earth-orbiting military or civilian remote sensing satellite scanning the entire Earth is gathering intelligence from domestic United States, only 1.8 % of the time. 98.2 % of the time it is gathering military,economic or other information from areas outside of the sovereign jurisdiction of the Constitution of the United States, or the Congress. This global power instrument has rendered all U.S. "foreign policy" obsolete. Members of the House Foreign Affairs Committee are almost fully uninformed of this new and future global power technology.

2. In one orbit of the Earth in approximately 103 minutes one "eye in the sky" satellite scans intimately all nations and oceans and other areas along its path, involving simultaneously the following House Committees:- Agriculture;Appropriations; Armed Services;Banking, Finance & Urban Affairs;Budget; Education & Labor;Foreign Affairs; Government Operations;Interior & Insular Affairs. Interstate & Foreign Commerce; Merchant Marine & Fisheries,Science & Technology;Select Committee on Intelligence; Joint Economic Committee, and all corresponding committees in the Senate. If the Science and Technology Committee does not assume responsibility for informing and educating the majority and minority members of all these committees, regarding these

new power technologies which intrude into the responsibilities of all corresponding legislative organisms inside every nation on Earth, who will?

3. Advancing science and technology (knowledge & skills in all professions) can not be kept "SECRET", except for short, temporary periods of time. Some specific applications of science and technology may be kept "secret" for a somewhat longer time. But for long range, or policy, or strategy planning it must be assumed that all knowledge and skills in time become the common heritage of humankind.

The American Government has not learned the harsh lesson of our past generation's false sense of security as we believed that America had the "SECRET" of the atom bomb.

The public and the Congress are deceived by the forced mythology of "military science and technology" (Armed Services Committee oversight) and "civilian science and technology" (Science and Technology Committee oversight).

Science and technology can only create force which becomes power when the force comes under command control of a human being or agency. Science and technology can be transformed into national power by the White House and Congress. National power is both military and civilian, simultaneously. It is the command control of U.S. national power which today is confused, paralyzed and increasingly impotent.

Example A:- THE NAVSTAR GLOBAL POSITIONING SYSTEM under development by the U.S. Air Force is projected to involve 24 earth orbiting satellites. NAVSTAR will provide accurate navigation to within thirty feet, and calculation of speed to within a fraction of a mile-per-hour, anywhere on Earth, instantly.

This navigation system will make it possible to direct an unmanned hydrogen bomb, or a tiny bomb, to within thirty feet of any target on the Earth . . . OR . . . NAVSTAR could serve the public safety by providing accurate navigation and traffic forecasting for all land, sea, air and space transportation of all 157 or more nations.

NAVSTAR can be a decisive American power instrument as we wield the Power of Death for humankind . . .OR . . . it can be the American power instrument for a new world statesmanship as we learn to wield the new Power of Life for humanity. America could provide a generation of leadership in developing the Power of Death, or the Power of Life, but neither the Congress nor the American people are allowed to make this agonizing appraisal. These life-and-death decisions for humanity are made behind thick walls of topocracy.

NAVSTAR could be a keystone in a new high commitment and purpose, if the Congress dares bring the subject into the daylight of public discussion.

Example B:- the recent SEASAT satellite experiment measured the temperature of the ocean's surface water, to within a small fraction of a degree, from space.

This information can serve the public safety world-wide, through improved weather and seastate forecasting. . . . OR . . .that identical instrument, in that same satellite, at that same instant can detect and trace the movement of a silent nuclear-powered hostile submarine, far under the surface, as the warm water . . .heated by the friction of the propellor . . .rises to the surface marking a progressive path in the surrounding cold water.

This identical advancing technology can provide American leadership toward the Power of War world-wide . . .OR . . .toward the Power of Peace for all mankind and womankind. These life-or-death decisions are manipulated behind walls of topocracy among the national security, military, foreign policy and science *advisors in the White House, beyond the view of the American people and the Congress as a whole.*

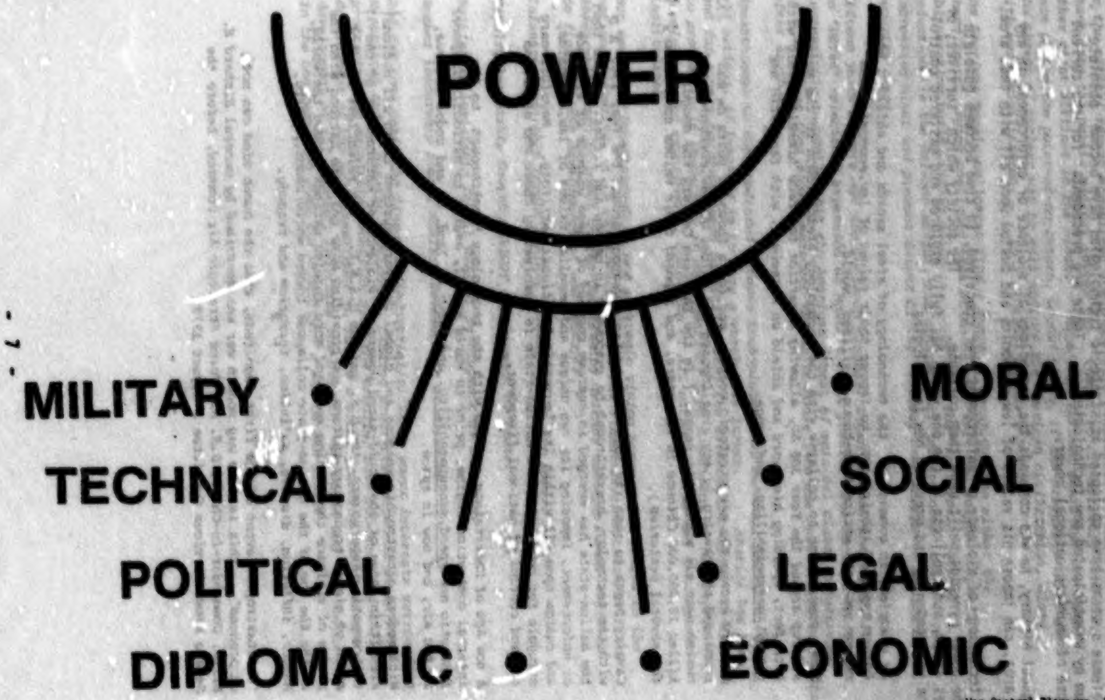
The recent Presidential Directive / NSC 54, dated November 16,1979 Subject: "Civil Operational Remote Sensing" (the subject of your hearing this week]was a classified document not publicly available to the Congress, the press or the public.

I can supply dozens, or perhaps a hundred, additional concrete examples of American advanced systems technologies which can be directed by a President and Congress as a commitment to the Power of Death for world civilization . . . . or as a far higher commitment to the Power of Life for future generations, everywhere. There can be no unified and coherent space policy, or science policy, until a President emerges who . . .with the support of or at the initiative of , the Congress . . .dares involve the American people in the historic decision as to the character and objectives of American Power in runaway world crisis. The House Science and Technology Committee may be the platform for this Dialogue of Life and Hope.

III. ADVANCING TECHNOLOGY AND THE COLLAPSE OF AMERICAN NATIONAL POWER

The national power within reach of a President and Congress, in time of crisis, is a *systems phenomenon* requiring continuous integration and direction of MILITARY-TECHNICAL-POLITICAL-DIPLOMATIC-LEGAL-ECONOMIC-SOCIAL-MORAL and other subsystems, welded into a single synergistic power far greater than the sum of its parts, and committed to a high purpose worthy of the suffering and sacrifice of the citizens involved.

(see visual)


POWER
MILITARY
TECHNICAL
POLITICAL
DIPLOMATIC
MORAL
SOCIAL
LEGAL
ECONOMIC

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As with any *systems phenomenon* if any one subsystem fails, the entire system fails. The following discussion will focus on concrete instances where in the past, political and defense systems have collapsed as strategic technologies have become obsolete . . . overrun by unanticipated new technologies. These are precedents for the current collapse of American national power.

Throughout history, he who commands the technology of violence or enforcement in any given area, can impose his values of law,economics and custom upon all with that area.

Every technology of violence or enforcement ever conceived, in time becomes obsolete and the power pyramids built upon them collapse. The society which survives, or emerges after, such collapse is the one which has fully explored and mastered control of the unprecedented and emerging new technologies.

As examples, in command of the technology of steel swords and shields, the Romans expanded their power to impose their values of law,economics and custom upon the entire then-known civilized world.

Roman power began to collapse with the technology breakthrough to the metal stirrup around the Year 300 AD, allowing a warrior to brace himself firmly with both feet, wielding his sword and shield on horseback, with fantastic new speed, maneuverability, and range.

Cavalry became the new strategic weapon, and for a thousand years he who commanded the cavalry in any area imposed his values of law,economics and custom upon all within his range. (In the Thirteen Century the Mongols killed 18,000,000 Chinese in ten years, and imposed their values upon China for several centuries).

Cavalry began to lose its role of "strategic weapon" around the Year 1300 A D with the technology breakthrough to gunpowder in cannon and rifles. Since then the nation-state has emerged in supreme command of these weapons of violence or enforcement, imposing its own unique and peculiar values of law,economics, and custom upon all within its "sovereign" national territory. Revolutionary struggle for power within a nation-state is resolved by those who establish command control of national firepower.

A new Age of Uncertainty emerged with the technology breakthrough to the internal combustion engine, prior to World War II, adding to national firepower fantastic new speed,maneuverability, and range on land, on and under the sea, in the air, and now in space.

With modern catastrophic weapons and global delivery systems today all nations are within range of the world-sized powers of violence or enforcement of the two competing superpowers, the U.S. and the U.S.S.R.. The relentless forward march of global technology systems, is providing more and more nations with the powers of violence threatening more and more foreign nations around the world, as the the age of the nation-state collapses toward world chaos,poverty, hunger, inflation, disease, pollution, terrorism and tragedy.

"A catastrophic event of the first magnitude, that the human mind can not comprehend" ... This is the way modern war was described by General Richard H. Ellis, Commander-in-Chief, U.S. Air Force Strategic Air Command, before the Senate Armed Services Committee 1 August 1979.

The American people today are like passengers in a giant airliner in a storm cloud filled with many other airplanes on potential collision courses, as the pilot (recent Republican and Democratic Presidents) continue to chant into the public address system the threat to fly directly into the other giant airliner in the cloud. More than fifteen years ago the arms race passed the point-of-no-return, beyond which, if the President makes good the threat of nuclear war he will rupture the American civilization, along with world civilization. . . in a suicidal kamikaze plunge.

The American people no longer find a sense of security from either the "hardliners" urging continued escalation of race for the weapons capable of obliterating world civiliz ation . . . nor from the "softliners" urging reductions in the defense budget, and disarmament, and weakness in the face of increasing clear and present danger of the runaway arms and power race and security chaos.

Fifteen years or more ago the Pentagon planners began to lose the capability to "DETER" relentless expansion of hostile world powers. Our enemies everywhere increasingly recognize that the American threat of suicidal global catastrophe is a bluff, as they slowly maneuver the White House into one nuclear confrontation after another.

Breakthrough to unprecedented defense technologies has become imperative for all nations, if humanity is to have a worthwhile future. America has had, and for a very few more years may still have, the advanced knowledge and skills to provide world leadership in an unheard-of high commitment to new research, development and experimental operation of all-nation defense and development institutions.

But each time breakthrough to new strategic vision becomes imperative to the national security, it is our tradition that the financial/industrial/military leadership risen to power on the obsolescing defense concepts, band together to fight AGAINST development of new concepts.

Infantry leadership fought AGAINST development of air power.

Cavalry leadership fought AGAINST development of tanks.

Battleship leadership fought AGAINST development of carriers.

Bomber leadership fought AGAINST development of missiles.

And for some years the financial/industrial/military power interests surrounding Republican and Democratic Presidents, finding protracted personal gains from protracted and escalating conflict with the Kremlin, have blocked and killed development of the high commitment to future systems guarding the defense and development of all nations, including the U.S.S.R. and China and the U.S., in the one remaining hope for humanity:- a WAR ON WAR ITSELF.

IV TO DEFEAT SOVIET EXPANSION WITHOUT THREAT OF WAR

The High Commitment to a New American Purpose

...in addition to meeting all requirements for national defense

...without having to "negotiate" with or beg permission of the Kremlin,to begin.

As President Kennedy refocused public attention away from the Cuban Invasion fiasco by the awesome commitment of American creativity and power to the task of making the Moon safe for human visits within a decade . . . . . a President of the United States, of either political party, and the Congress, can now electrify world populations on both sides of all current potential wars . . . and can refocus the anxieties of the human billions crushed by hunger,poverty,disease,inflation,terror,oppression and tragedy (as summarized this week in the White House White Paper titled "Global 2000") by the historic commitment of the creativity,power and character of the American people . . . . unleashed and guided through the new World Order Council in the White House . . . and carried onward by a new generation of FORWARD PLATOONS of Americans commited to the long range safety and wellbeing of their enemies and their neighbors as for themselves . . .toward the distant goal of a civilized world order and institutions.

As in recent times the police profession reached beyond merely maintaining the "fastest gun in town" to pioneer a new *crime prevention profession* . . .now the U.S. Military and Intelligence Establishment can be led beyond merely maintaining traditional weapons of defense, to lead the world,joining with civilian sectors, to create a new and unprecedented *war prevention profession* world-wide.

For more than twelve years the United States, the Soviet Union and more than a hundred other nations have been working their ways through the jungle trails, and unexplored frontiers of the LAW OF THE SEA CONFERENCES. This has been one more example of the tedious and difficult challenge, and the historic imperative,of the nations on this crowded planet climbing awkwardly up the steps toward eventual world peace through law, maintained by unprecedented world-sized institutions. This task is not yet completed, but the delicate balance of all-nation relations may collapse if the LAW OF THE SEA CONFERENCES fail. Progress is being made. For the first time in history advancing technologies have made feasible (1) recovery of the resources and wealth on and under the sea bottom, and (2) enforcement of a future Law of the Sea, with justice among all nations.

In this same frontier direction the following are but a very few examples of new world institutions now becoming feasible for the first time in history, due to the progress in global systems technologies and management skills. These are but a few of the high commitments which might well have been pertinent to have been on the agenda of your hearings this week, as space science and technology set the pace for progress in all fields of knowledge.Space technology has made most of the following feasible.

1. WORLD LAND,SEA & AIR POLLUTION MONITORING AND FORECASTING SERVICE CENTERS

2. WORLD FOOD & FIBRE INVENTORY AND FORECASTING SERVICE CENTERS

3. WORLD FOREST INVENTORY, MONITORING AND FORECASTING SERVICE CENTERS

4 WORLD ARABLE LAND INVENTORY, MONITORING AND FORECASTING SERVICE CENTERS

5. WORLD WEATHER & CLIMATE MONITORING AND FORECASTING SERVICE CENTERS

6. WORLD LAND AND HYDROGRAPHIC MAPPING SERVICE CENTERS

7. WORLD AIR TRAFFIC CONTROL SERVICE CENTERS

8. WORLD SEA SURFACE AND UNDERSEA TRAFFIC CONTROL SERVICE CENTERS

9. WORLD COMMUNICATIONS ADMINISTRATION CENTERS

10. WORLD DISASTER WATCH SERVICES

    (war,pollution,hurricane,drought,blight,pestilence,earthquake, shipwreck, et

11. WORLD SEARCH AND RESCUE SERVICE CENTERS

12. WORLD ECONOMIC INTELLIGENCE SERVICE CENTERS

13. WORLD "OPEN CHANNEL" MILITARY INTELLIGENCE SERVICE CENTERS

    (Each nation maintaining its own "secrets" as long as necessary,and then releasing the intelligence for world public awareness, or releasing intelligence other nations are keeping "secret")

14. WORLD ARMS CONTROL AND PEACE-KEEPING MILITARY INTELLIGENCE NETWORK

    (along the lines of the all-nation satellite intelligence service called for by the President of France in the U.N.General Assembly May 1978. The U.S. abstained from voting.)

15. WORLD INTER-NATION ADVANCE CONFLICT WARNING SERVICE CENTERS

16. ALL-NATION WAR PREVENTION FORCES

17. ALL-NATION WAR PREVENTION COLLEGES

18. ALL-NATION WAR PREVENTION GAMES

19. ELECTRONIC & SATELLITE NATIONAL BORDER PROTECTION SYSTEMS & FORCES

20. WORLD LIBRARY AND INFORMATION COMMUNICATIONS SERVICES

21. WORLD PUBLIC HEALTH INFORMATION AND DIAGNOSIS SERVICES

22. A GLOBAL INFORMATION COMPLEX

    (the attached projection was published first in the FUTURE SPACE PROGRAMS 1975 hearings of the Space Science and Applications Subcommittee. It was published again in June 1979 Aerospace and Electronic Systems Society Newsletter, within the Institute of Electrical and Electronic Engineers - IEEE. On 1 July 1979 is was published again by the press review service in the Pentagon for dissemination to top military and civilian Defense Department leadership, world-wide. The White House or the Congres could refocus world attention tomorrow, as all elements are available. The White House has refused to discuss the subject.)

(For the purpose of expanding pro and con and creative professional and public discussion Melvin Abramovich, Editor of AESS/IEEE Newsletter, has granted to any other editors the rights to publish this projection from the June 1979 issue, with credits.)

A Global Information Complex

by Howard and Harriet Kurtz

WAR CONTROL PLANNERS, INC.
Box 19127
Washington, D.C. 20036

The following are excerpts from testimony prepared for the House Subcommittee on Space Science and Application of the 94th Congress. In view of impending space legislation, they are presented to spark creative ideas and suggestions from IEEE membership.

EXPANDED GODDARD SPACE CENTER: WINDOW TO THE FUTURE

Goddard Space Center in the Maryland outskirts of Washington, D.C. already is the nerve center through which global remote sensing space technology data are transformed into information serving the needs of an increasing number of world-wide users.

Although thousands of creative persons in NASA and in the other government departments and agencies as well as in corporations and research centers working under contract to NASA have for more than ten years envisioned and developed the awesome and unprecedented capabilities of earth-orbiting meteorological and communications and earth resources survey and other humane applications satellites, the leadership to these new realities has emanated from the scientists, engineers and experts at Goddard.

We are suggesting now that the size and the facilities and the mission of Goddard Space Center be greatly expanded to provide the same leading edge for a new generation of all-nation, or global, research, development, testing and evaluation (and eventual shared operation with other nations) of space systems and institutions serving the common needs of all nations, large and small. This center should coordinate the facilities of other government departments and agencies dealing with space applications.

The President and Congress could focus world attention on Goddard as the coordinating center for a historic commitment of the American people to a new American purpose . . . a decade of gradual redirection of American creativity and power to the pioneering of global systems and structures to serve the basic needs of all nations for progress and independence and security.

As its function expands Goddard will be opened up to the people of the world. All work will be conducted with information which is in the public domain. No classified information or national secrets of any nation will be allowed into the new *GLOBAL INFORMATION COMPLEX*. On a large scale the activities of the new complex will with its many layers comprise a center of concern for humanity.

1. Continued Research and Development

Budgets for pro-human applications satellite development will be increased to four or five times the present modest amounts, as a validation of the American national commitment. Goddard will continue to set the forward creative pace, not only for American research and development in this area, but for the creative people of all nations who will be invited and welcomed.

Governmental or independent research organizations of all nations will be invited to establish their own subsidiary groups of their own research centers located in or near the Goddard *GLOBAL INFORMATION COMPLEX*, to work cooperatively in joint or common new directions with the scientists, engineers and professional experts of all pertinent disciplines from all interested nations.

Facilities will be maintained to bring in experts from anywhere in the world for shorter periods of consultation.

Facilities will be maintained for representatives of scientific and professional societies in all pertinent fields, from all nations, to maintain liaison offices within the complex. Science advisors from all embassies in Washington will be welcome.

2. Storage of Scientific Information

At the present time at Goddard there is a National Space Science Data Center, where refined basic scientific information and data are stored for reference and future use for all outer-space science activities.

On a far larger scale a new *EARTH APPLICATIONS SPACE DATA CENTER* will be created to become the central reservoir of accumulated knowledge relating to space programs and applications directed toward the earth and its populations. Libraries and universities and laboratories of all nations will have access to this reservoir of knowledge, and ways will be developed to create similar satellite data centers in other regions of the planet, linked to the central information storage.

A technical information facility will be maintained to assure maximum cooperation with all other channels for the communication of technical information to scientists and engineers and professional specialists and individuals, world-wide, as an expansion of the present NASA Technical Information Facility.

3. Active Interface with Users

The breakthrough technologies to serve the needs of nations and people are of little value, until the organizations and nations and people who could use the new intelligence understand what new services are within their reach, and they learn how to make maximum utilization of the services. This involves a world-wide

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two-way continuous communications network (1) with the creative research center understanding the needs of potential users everywhere, and (2) the potential users everywhere learning how to take maximum advantage from the services.

This back and forth dependence upon each other will require continuing active interface and liaison between the Goddard *GLOBAL INFORMATION COMPLEX* and local governments, state governments, regional institutions, national governmental departments and agencies, universities, high schools, corporations, and individuals within the United States . . . and through proper channels with the same sectors of all other nations around the world . . . and through other channels with the pertinent structures within the United Nations and other world institutions (such as, for example, the World Court in relation to future litigation). All of these activities are being pioneered on small budgets by NASA, by the Agency for International Development, by the Department of the Interior, by the Department of Agriculture, etc. . . . but the nations of the world have become confused and discouraged in the last year as they learned that the Office of Management and Budget in the White House was threatening to kill *all* budgets for future LANDSAT satellite development. The new Goddard Complex and be evidence before the world that the United States and the American people have made a long range, sustained, continuing national commitment to the welfare of humanity.

Experts and students will be brought in from other nations, sent by their own governments, to study the uses and the new techniques continually being developed . . . and experts and teachers will be sent out at the request of other governments to conduct training and education in the areas of the users.

Two-way communication will bring all complaints and inadequacies from the users around the world to the creative center at Goddard, with answers or improvements flowing back to the users.

Nations or organizations will be expected to pay their expenses and the costs of training, but policies will be developed for those deserving but unable to pay, with the provision of fellowships and other aids.

4. *The Global Information Sciences Institute*

Universities and institutes within all nations will be invited to assign advanced students and professors to study or to instruct at a new *GLOBAL INFORMATION SCIENCES INSTITUTE* at Goddard, and to work cooperatively with the research centers of the *GLOBAL INFORMATION COMPLEX* to both lead and follow the creative pioneering probes into future pro-human and life-supporting space systems.

5. *Global Information Conference Centers*

Facilities will be created at Goddard where multinational or all-nation symposia and conferences may be held at regular intervals to clarify and communicate the latest developments . . . where policy review conferences may be held among the governments of the world and the space information experts . . . where conceptual conferences can call upon participants to project the future operational requirements for as-yet-unthought-of future space projects . . . where experts in space information services for the planet may work in frequent interface with experts in many other fields of the emerging world community of nations.

6. *The Public Experience*

A very, very large exhibition hall and information display center will be built which might become the greatest tourist center in the world. The creative imagination of the public information professionals already translating space efforts into visual displays, if invited to offer ideas, could make the public rooms at Goddard more exciting than any world's fair.

Large and vivid audio-visual displays will give the public the vicarious experience of looking down upon mankind on the Spaceship Earth, and experiencing the almost-impossible-to-describe realities of what can be "seen" and discerned and recognized to serve the needs of humanity on the Earth below.

Large information display walls will allow the public to look (in real time or in later replay from computers) down upon events unfolding on the Planet Earth.

The press corps, with journalists from all nations, will have full access to the inflow of open-to-the-public global intelligence. Television networks and stations of the world will have direct electronic connections to the satellites in orbit, so that world events or disasters or dramatic rescues or battlefields or earthquakes or just the awesome and wondrous beauty of the Earth from space may be seen in real time on the TV screens of the world.

Students with dreams of future careers committed to making the Earth a safe and decent place to live will come to the visual experience center and may see openings for their own personal career commitments . . . taking home the preliminary literature and elementary books on sale at the *IN ORBIT BOOK STORE* connected to the looking-down-on-planet-earth public experience center.

Students at the *GLOBAL INFORMATION SCIENCES INSTITUTE* might earn tuition by answering questions from the peoples of the world moving through the exhibit and taking home a picture postcard of their own home town, anywhere, taken from outerspace.

7. *New Ideas . . New Opportunities . . New Hope*

Throughout the ages whatever people have been able to envision, eventually they have been able to create. The shocking new reality of modern creative research and development power is that humanity for the first time in history can create any kind of future world order it can envision, and is willing to make the massive commitment to achieve. Looking at humanity and looking at the Planet Earth from the new vantage point of instruments in outerspace, one's imagination is released to begin envisioning dozens or hundreds or thousands of new ways to help all humanity live through crises and develop unprecedented well-being, as readily as military planners can envision new ways to kill more people in less time over a greater distance.

As at first hundreds, then thousands, then millions of people encounter the personal experience sensations of the Goddard audio-visual information display complex, the creative imaginations of human beings will be released and humanity gradually will envision, and then create, the institutions, the systems, the structures, the devices, the tactics, the jobs related to a safe and decent future for humankind, trapped and forced to live on Planet Earth. There is valid reason for hope, but too few people are able to experience this reason for hope.

The great global defense/space/communications/command control and other systems teams will be put to work on an unprecedented scale, doing what they do best . . . pioneering utterly complex global systems.

23. GLOBAL INFORMATION COOPERATIVE - A New American Purpose

(This projection of a high commitment of American space power, involving nearly all other professions and fields of knowledge, was published first from personal testimony before the Senate Subcommittee on Science, Technology and Space, on March 18,1977. This was Harriet's last public appearance before her death June 17,1977, and was her bequest to the rising generations of all races, colors, creeds and nationalities, around the world, from her lifetime commitment to search for, and to help clarify, purposes and objectives of America's advancing science , technology and management skills which were far higher and larger than our past generations' commitment to "win" the race to produce the weapons capable of annihilating the Human Experiment and bringing an effective end to history.

The American people, she believed, were capable of greatness and nobility far beyond the limited vision of the financial/industrial/military power interests which have surrounded,and suffocated, Republican and Democratic Presidents for more than a generation.

NOTE: This and all of the above are IN ADDITION TO maintaining requirements for national defense.

NOTE: This and all above initiatives can be committed and launched and carried through for many years without first asking permission of the Kremlin, or "negotiating" with potential enemies.

(See next four pages)

I am not seeking your support or endorsement for any program or political action. I am not a lobbyist. The purpose of this communication is to stimulate widest possible pro and con and creative, professional,public and political discussion . . . world-wide . . .of America's dwindling opportunities for new world statesmanship, before it is too late. Time may be running out for America.

Howard G. Kurtz

respectfully HOWARD G. KURTZ

Toward tomorrow's science and technology of life and hope for humanity . . . .

Global Information Cooperative

A NEW AMERICAN PURPOSE

Excerpts from testimony before the United States Senate
Committee on Commerce,Science and Transportation
Subcommittee on Science,Technology and Space
March 18,1977

by Harriet and Howard Kurtz
Editors of CHECKPOINT
Newsletter of War Control Planners, Inc.

WHICH WAY IS THE FUTURE FROM HERE? It may be important for the Senate as a whole to stand back away from the confusion of day-to-day world crises to find the right road into the future. This is a subject which is never discussed publicly.

There are about 157 sovereign nations on the planet. The people of these nations have not attached their support to either Kremlin or White House side of the generation-long science and technology race producing weapons capable of annihilating world populations.

The people of these nations have instinctive yearnings for protection from all foreign enemies . . .for political independence . . .and for progress toward a worthwhile future . . .the three "gut issues" for which the American people fought and won their Revolution two hundred years ago.

The nation which will emerge as the inspiration and the pace-setter for all other nations in the next generation will not be the superpower continuously "winning" the race to produce the weapons capable of killing off every man,woman and child now alive on the Earth . . .but will be the superpower pioneering the new frontiers of civilized global systems and institutions capable of guarding the national security . . . and political independence . . .and internal progress of all nations.

The United States today has a dominant lead in the global systems technologies and management skills with which to provide a next generation "race" inviting (challenging) all nations to develop world-sized institutions to conserve and enrich life for the people of all nations. The earth-orbiting,life-preserving satellite systems are but one concrete example of pro-human world systems within ready reach of the Congress and the President . . tested,proven and ready to be mobilized under a new U.S. grand strategy.

The scientists, engineers and specialists in these life-saving global systems technologies are explosively ready to be unleashed to chart a new historic course for the future . . .awaiting as they have for some years only the sufficiently large vision and commitment by the Congress, the President and the Office of Management and Budget.

The LANDSAT satellite in one orbit of the Earth in approximately 103 minutes invade the privacy of every sovereign nation in its 115 miles wide path.

This creates one of the most complex and difficult "foreign relations" problem in history. Once every eighteen days this one LANDSAT satellite inspects in increasing minute detail the sovereign territory of every other nation on the planet . . .friend or foe. Yet there is no indication that the Senate and House Foreign Relations and International Affairs Committees have even a preliminary education on these global tools which have been operating for more than four years.

This is only one small part of the problem the Senate faces. In one orbit of the Earth in 103 minutes this one "eye in the sky" satellite involves the direct and immediate responsibility of at least twenty-four Committees in the Senate and the House of Representatives,simultaneously. Your subcommittee is quite bold to allow the subject to be even mentioned. Other Committees have refused to allow discusion of the subject because " it is beyond the jurisdiction or the authority of this Committee". This suggests the way in which the Congress has neglected its responsibility to determine the character and the objectives of U.S. global science and technology.

During the eighteen days it takes one LANDSAT satellite to cover the entire Earth its instruments are recording what is seen and transmitting this data for permanent storage in ground computers for sovereign United States territory only 1.8 % of the time. 98.2 % of this time LANDSAT is gathering intelligence or information from territory that is foreign to the U.S. Wholly new and up-to-date U.S. foreign policy and grand strategy have become imperative, as LANDSAT may act as the instrument to convince all the nations in the world that U.S. multinational corporations are receiving preferred access to the energies and resources and potential intelligence to gain economic dominion over these nations . . .or LANDSAT ca. become the leading edge instrument of a transcendent new U.S. national commitment to help all nations in their struggles for their own future security and progress.

Do "eye in the sky" satellites involve military science and technology or civilian science and technology? One of the emerging satellite systems will contain instruments which will measure the temperature of the surface of the oceans hundreds of miles below, to with a fraction of a degree accuracy. This will be of added value for civilian weather forecasting and for civilian seastate forecasting for ocean shipping. But this same instrument at this same instant will be able to detect the faint trail of slightly warmer water rising to the surface, heated by the friction of the propeller of a silent nuclear submarine against the surrounding water, causing the warmer water to rise to the surface, leaving a tell-tale trail of warmer surface water to mark the path of the military submarine. From here on out the development of military and civilian earth-observation satellites will increasingly overlap. Satellites monitoring the inventories of crops near a national border also will record the movement of troops across that border. Satellites monitoring the pollution of rivers from sewage or oil spills also will detect the pollution of the same river from the production of nuclear or other weapons.

A FEW CONCRETE EXAMPLES OF SATELLITE GLOBAL SERVICES

Trained geologists using LANDSAT imagery are able to analyze lineaments and geologic faults and other surface signs to assist in locating new underground gas and oil and water and mineral resources within the borders of all nations. The giant American multinational corporations can afford the services of trained scientists and expensive computerized analyses, to this prospecting from the sky before the governments of the other nations become aware of their own potential wealth. The poorer nations can not afford to have the scientists and the expensive equipment to take advantage of the LANDSAT imagery. Should the multinational corporations determine the United States attitude toward the nations of the world, or should the Congress and the President establish the character and purposes of U.S. global intelligence and information systems?

With a million human beings on the planet facing slow death through starvation, and disease and ignorance the earth-serving satellites can provide the global systems foundation for world-wide inventories of all crops and fibres . . . providing computerized analyses of the world's different crops . . .the health or disease of these crops . . .the progress of growth . . . the projected crop yields at least 60 days in advance of the harvest. Should Kremlin strategists have a monopoly of such global agricultural intelligence service? Should American powerful Agribusiness Interests have privileged advance access to this projection of world-wide food and fibre crops and prices? Should there be some kind of GLOBAL INFORMATION SERVICES in which all nations have a cooperative voice on the policy level of management.

World-wide forestry information services can be provided with satellite intelligence, to help all nations maintain current inventories of their forests . . . the kinds of trees . . the health of the trees . . .the state of growth of the trees . . .the location and extent of forest fires. As in all of the above cases, the U.S. is now in a position to take strong leadership developing the global systems and institutions to serve the needs of all nations, in a new generation of world statesmanship.

World-wide inventory can be maintained for all arable land as part of future world systems to bring an end to famines and malnutrition. The U.S. already is taking small initiatives in this direction, without the thrust of a new national policy proclaimed by the Congress and the President.

The U.S. can assume world leadership assisting all nations in the task of mapping their own territory, in detail, from outerspace observations, at costs a small fraction of the expense of traditional mapping for underdeveloped areas. The Pentagon through the Defense Mapping Agency for some years has been helping Central and South American nations in mapping their own territories from space imagery, as part of military cooperation agreements. The U.S. Geologic Survey which is the leader in civilian mapping capabilities from space imagery also can be given the added mandate to assist all nations in mapping and in educating and training their own citizens in this new field.

Communications and broadcast satellites could play equally vital roles in the new and larger U.S. Foreign Policy.

In a successful experiment with the ATS-6 satellite a professor of anatomy and pathology at the University of Washington in Seattle, Washington, conducted a full semester class with students more than fifteen hundred miles away, in Alaska. The students watched and heard the professor and his experiments, through TV relayed both ways by broadcast satellite . . with a closer look at the experiment than if they had been sitting in the room with the professor. The professor could see and talk to and question his individual students via television. In the next twenty years with strong U.S. world leadership high quality education can be brought to the uneducated masses of world populations, through coordinated efforts with the nations involved. These "teacher in the sky" satellites can open the gate to a new era of hope and progress for all humanity. Tragically the White House Office of Management and Budget several years ago forced NASA to abandon creative development in this field, and now Canada and Germany and Japan have surpassed the American capabilities to serve the future needs of world populations. The White House made a mistake.

In another successful experiment in Alaska damaged babies and injured or sick adults in remote villages 500 miles from a doctor, were examined and treated regularly by a distant doctor through two-way television relayed via the broadcast satellite. Combined with a generation of outreaching medical and public health education the "doctor in the sky" satellites gradually could help bring health to world populations. NASA creative work here also was killed by the Office of Management and Budget, without sufficient objection coming from the Congress.

We have run out of time but please permit us to make two points:- (1) we have mentioned only a small fraction of the satellite capabilities to help the nations and the peoples of the world in their legitimate struggles for security and progress, and (2) within NASA and each of the other agencies and departments

There are very large backlogs of valid, feasible, pro-human new concepts and services waiting to be put into the creative stream of research,development, testing, demonstration and eventual operation to assist all nations in their struggles for a worthwhile future. These great potentials for U.S. world inspiration and statesmanship will remain inactive, and unemployed, until the Congress and the President speak for the American people in proclaiming a New American Purpose . . . and enlarge the mandate and the budget to release this frustrated creativity and concern for humanity-as-a-whole.

SUMMARY

The relentless forward march of science and technology (knowledge and skills in all fields) follows a back-and-forth . . . or PENDULUM SWING . . .pattern. Advancing knowledge and skills making possible JET BOMBERS to kill people at new magnitudes and distances, then made possible the PENDULUM SWING in the opposite direction and production of JET TRANSPORT PLANES bringing people closer together into new world community.

On a far larger scale the generation-long Kremlin/White House science and technology race now producing weapons capable of rupturing or annihilating national civilizations has created a unique historic moment . . . today . . .the moment to begin the next-generation PENDULUM SWING in the opposite direction with new waves of research and development and commitment directed toward global systems and institutions of a civilized world order guarding the security and progress of all nations, large and small.

The U.S. will have a strong lead in the necessary global systems capabilities for a few more years. The earth-orbiting, life-serving satellite systems are but one valid example of the future world-sized systems to preserve humanity, rather than threatening its extinction.

*** Thank you,Mr. Chairman ***

HOW TO PREPARE FOR CAREERS ON THE FRONTIER OF A CIVILIZED WORLD ORDER

For American citizens of all ages, in and out of government, and in or out of educational institutions, who want to join in or encourage new careers pioneering MILITARY-TECHNICAL-INTELLIGENCE-POLITICAL-DIPLOMATIC-LEGAL-ECONOMIC-SOCIAL-MORAL frontiers of lasting world peace and progress . . . and for their counterparts in every other nation around the world, and within the United Nations structures.-

CREATIVE ACTION: Write to Ms. Gloria Reagan, Editor of WRAPPER, National Aeronautics and Space Administration, Ames Research Center, Moffett Field, California 94035 USA. Ask to be placed on her mailing list, and for back issues. WRAP stands for Western Regional Applications Program. The purpose of this free newsletter is to allow the general public, educators, and officials of local and State Governments, and the press, of the Western States of the U.S. to become increasingly familiar with the great and lasting benefits to all layers of society from the earth-orbiting, life-serving NASA satellite systems. By law NASA is charged with making this information available to the people of the world. But you have to ask for it. NASA is not allowed to do a "sales job" or "public promotion".

CREATIVE ACTION: Write to Dr. William A. Fischer, Chief Scientist, Earth Resources Observation Service, U.S.Geologic Survey, Reston Square, Reston, Virginia 22090 USA. Tell him the general area of your interest and concern, and ask him how you can keep well informed about the work his organization is pioneering to help all nations, including our own, gain maximum advantage from the "eye in the sky" satellites which today are gathering economic development intelligence from within the boundaries of all nations. Once again you have to ask for this information, but you are entitled to it.

TOWARD THE FRONTIERS OF A FUTURE CIVILIZED WORLD ORDER

BIOGRAPHICAL BACKGROUND: Harriet B. Kurtz (1915-1977) & Howard G. Kurtz
Co-founders of War Control Planners, Inc.

The arms race is almost beyond control. It is causing uncontrollable world-wide inflation. The foundations of world civilization are collapsing. Hope for the future is running dry all around the world. Only a miracle may avert approaching tragedy.

Mr. and Mrs. Kurtz spent more than thirty years study,observation and writing in the field of escalating world crisis in search for this 'miracle' . . .bold,unprecedented, creative initiatives the American people could unleash, through their Government, in the coming generation to lead the 157 or more sovereign nations toward a civilized world order free from war and free from want.

Harriet and Howard began their search with graduate study at The Russian Institute at Columbia University (1946-48). Harriet had graduated from Wellesley College as a Bible Major in 1937. Howard had graduated from Pennsylvania State College in 1930 as an Industrial Management Major, having graduated in 1929 from the U.S. Army Air Corps Flying School as a pilot, later to become a Lt. Col.in the U.S. Air Corps.

Realizing that, for the first time in history, men behind high walls of top secrecy in the Kremlin and in the White House were in confrontation, brandishing the power to destroy mankind (a power the mythologies of most religions had always claimed that God alone could command) Harriet embarked upon further study at Union Theological Seminary in New York, receiving her Master of Divinity degree in 1962. As it became increasingly obvious that neither the secret planners in the Kremlin or the White House had great vision, or noble purposes, appropriate to the unprecedented command of God-sized powers of death-or-life, Harriet and Howard intensified their search.

They founded War Control Planners, Inc in 1963 as a non-profit, tax exempt vehicle for this search, and began to publish its newsletter CHECKPOINT in 1968, for the increasing numbers of people expressing a desire to follow their progress.

In 1964 Harriet was ordained into the ministry in the First Congregational Church of Chappaqua N.Y., in a unique ceremony in which Catholic, Jewish, Ethical Culture, Unitarian and many different Protestant Clergy participated. She was ordained with the quiet belief that people of all Faiths, and those professing no Faith, were created in the image of God, and therefore they possessed creative powers:- powers to create new history rather than remain chained to dead history of past wars, and agony.

Howard spent twenty-two years (1932-1954) in key airline management positions in American Airlines, Inc.,American Overseas Airlines, Inc., and Pan American World Airways. He then spent twelve years (1954-1966) as the Senior Associate in the nationally known management consulting firm of Handy Associates, Inc. Since 1966 Howard has devoted full time and energy to War Control Planners, Inc., as did Harriet until her death June 17, 1977.

As President Roosevelt (1) prosecuted World War II and in addition (2) released the creativity of America in the Manhattan Project for unprecedented breakthrough to atomic power, so today the President of the U.S. can (1) meet all requirements for national defense, and in addition (2) release the creativity,power and character of America for the breakthrough development of global systems and institutions guarding the security and progress of all nations, our enemies and our neighbors as ourselves, as Air Traffic Control guards the safety and progress of all airplanes in a cloud. This would be The Golden Rule in international relations, the most "radical" idea in history. Missing is a White House commitment to such research and development.

over..................

Partial list of publications of conceptual projections by the late Harriet B. Kurtz, and Howard G. Kurtz co-founders of War Control Planners, Inc., Box 19127, Washington D.C. 20016 on the next-generation challenge for advancing science,technology and management skills:- GLOBAL WAR PREVENTION SYSTEMS . . .ALL-NATION SECURITY AND DEVELOPMENT SYSTEMS . . . LIFE SUPPORT SYSTEMS FOR PLANET EARTH . . . GLOBAL COMPASSIONATE POWER SYSTEMS.

January 1979	SEA POWER (The Navy League) "Satellites for Peace" pg 14
Winter 1978/79	CO-EVOLUTION QUARTERLY (a) Draft Speech 1966 for possible delivery in 1966 by President Lyndon B. Johnson (b) editorial by Stewart Brand (c) perspective by Astronaut Russell Schweickart (d) up-date by Howard G. Kurtz 12 years later. (Above placed in Congressional Record for February 13,1979 by Congressman George E. Brown, Jr. (Dem.Cal.) with his own added perspectives.
1978 Volume 6 Number 1	REMOTE SENSING OF ENVIRONMENT - an interdisciplinary, international journal. A three page editorial.
January 1976	FUTURE SPACE PROGRAMS hearings of the Committee on Science and Technology, U.S. House of Representatives (pages 649 thru 654) "A Policy Perspectives Paper on A GLOBAL INFORMATION COOPERATIVE".
October 24,1977	AIR FORCE TIMES editorial commentary "Time to Give Military Due Credit".
August 1,1977	AIR FORCE TIMES a eulogy to the life and witness of Harriet B. Kurtz " A PLAN TO DO AWAY WITH WARS " by editor Bruce Callander.
March 18,1977	NASA AUTHORIZATION FOR FISCAL YEAR 1978 hearings by Subcommittee on Science, Technology and Space, of the Senate Committee on Commerce, Science and Transportation (page 1772 thru 1787) testimony by Harriet and Howard Kurtz on unleashing U.S. strategic power initiatives in A GLOBAL INFORMATION COOPERATIVE.
November 29,1976	NAVY TIMES "DATA-SHARING SYSTEM - - COUPLE WORKS FOR PEACE THROUGH TECHNOLOGY"
August 1976	SPACE WORLD - The Magazine of Space News (pgs 5 thru 29) "LIFE SUPPORT SYSTEMS FOR PLANET EARTH - -SPACE SATELLITES AND THEIR POTENTIAL FOR ESTABLISHING WORLD PEACE ".
September 1975	FUTURE SPACE PROGRAMS 1975 hearings by Subcommittee on Space Science and Applications, of the Committee on Science and Technology, U.S. House of Representatives (Vol. II pgs 603 thru 633) testimony by Harriet and Howard Kurtz on U.S. world leadership toward the world-sized systems and institutions of a future civilized world order.
December 1973	SPECTRUM journal of the Institute of Electrical and Electronic Engineers -IEEE "Scanning the Earth" to concrete projection for the mobilization of U.S. military and civilian earth-serving remote sensing and communications satellites toward a future "GLOBAL INFORMATION COOPERATIVE"
November 1,1970	THE SPACE LETTER space industry executive newsletter and simultaneously published in TEMPO December 1970, journal of the National Council of Churches, "LIFE SUPPORT SYSTEMS FOR PLANET EARTH"
May 1969	MILITARY REVIEW journal of the U.S. Army Command and General Staff College "The Collapse of U.S. Global Strategy" by Harriet and Howard Kurtz reporting the end of the historic era in which tribes and nations sought security by escalating their weapons of destruction, as weapons of destruction passed the point-of-no-return beyond which the nation making good its threat of aerospace/nuclear war, itself would risk obliteration in the holocaust . . . and projecting the elements of the long range strategic objective of an all-nation military and civilian system and institution , guarding the security and progress of all nations, as Air Traffic Control guards the safety and progress of all airplanes in a cloud.
October 1955	PUBLIC RELATIONS JOURNAL (Public Relations Society of America) "SURVIVAL - - NEW DIMENSION PUBLIC RELATIONS RESPONSIBILITY" discussing the missing factor in White House global power management and objectives: the impact on the anxieties and loyalties of the citizens of all nations on the planet.
September 1957	AMERICAN ENGINEER (National Society of Professional Engineers) "ENGINEER VS. WAR" a pioneering probe into the phenomenon of "war-peace-war-peace-war-peace" which has plagued all history, and clarifying the disciplines required to bring the plague to an end, before it destroys world civilization.

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